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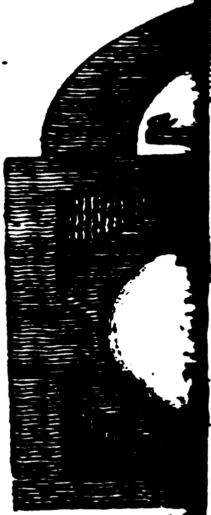

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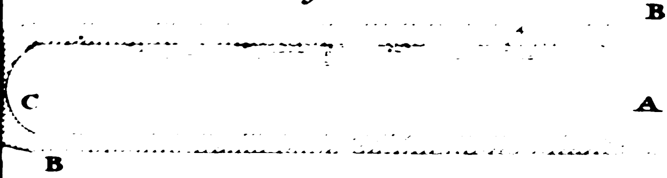

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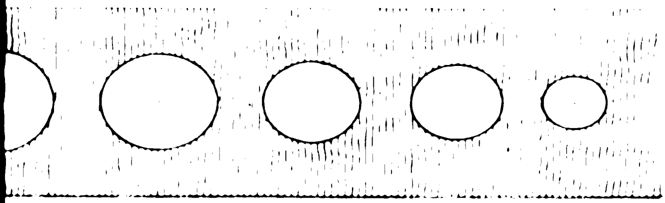

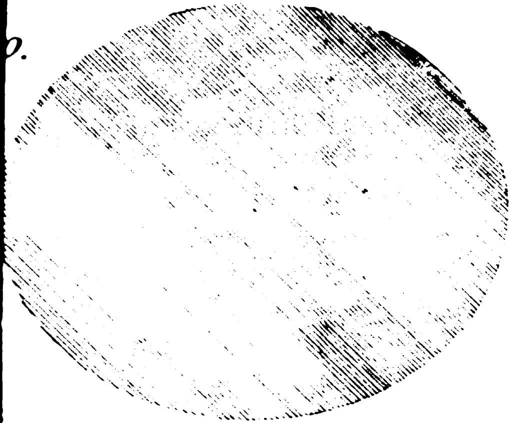

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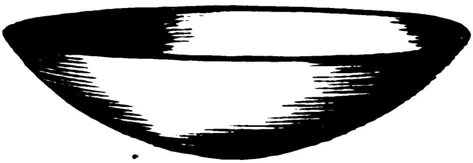

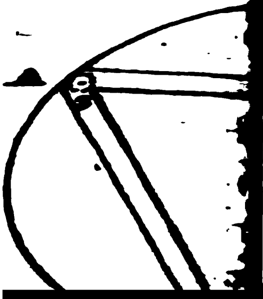

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No. LXXIX. SECOND SERIES. Dec. 1808.

Specification of the Patent granted to WILLIAM CONGREVE, *of Garden Court, in the County of Middlesex, Esquire; for a new Principle of measuring Time, and constructing Clocks and Chronometers.*

Dated August 24, 1808.

With Engravings.

TO all to whom these presents shall come, &c. NOW KNOW YE, that in compliance with the said proviso, I the said William Congreve do declare that my invention is described in manner following; that is to say: The new principle or system of measuring time, and constructing clocks and chronometers, which is the basis of this patent, is founded on certain modes, hereinafter specified, of detaching the time-measurer from the first mover, for an extent of duration far beyond any thing ever yet effected or proposed, and which is not confined within the limits of ordinary detachments. Thus, the only detachments hitherto effected have either been limited to a period somewhat less than the smallest portion of time indicated by the vibrations of their time-measurer, and have therefore seldom been extended beyond seconds; or they have been effected by the intervention of an auxiliary power between the first mover and the time-measurer, which indeed ought scarcely to be considered as falling within the class of detached movements, as the time-measurer when discharged from the maintaining power is, in this case, still combined with another force. But by the system here specified, the duration of the detachment of the time-measurer from the first mover may, without the intervention of any intermediate power, be extended to a period comprehending any number of the smaller portions of time indicated by the time-measurer; in other words, the time-measurer shall indicate seconds, or any smaller division, and yet it shall be absolutely detached from the maintaining power for a period of one or more minutes.

This, therefore, gives a most distinct and definable character to this new mode of measuring time; the leading property of which is, a new and extremely extended detachment, and which I have therefore denominated the *mode of extreme detachment.* Before I proceed, however, to the several plans for effecting it, I shall briefly state its principal advantages.

The great difficulty of combining the actions of the regulating principle of clocks with the maintaining power, so that the regulating organ should be operated upon freely and uniformly by the pure action of gravity, neither accelerated nor retarded by the non-accordance of the first mover, has long since pointed out that the only true system of effecting this desideratum was by detaching them, as much as possible, rather than by

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combination. With the ordinary regulators, that is to say, with the common pendulum or balance-wheel, the extent of this principle of detachment, as already observed, is extremely limited; for, as with the most perfect detached escapement in use, the maintaining power is allowed to act on the pendulum for a certain portion of every oscillation, it follows, that with the common pendulum it would be extremely inconvenient to detach the first power for an interval much longer than a second, in so high a law do the lengths of pendulums increase as to their times; so that to obtain a detachment of 2″ would require a pendulum of 13 feet 0,512 inches in length; to obtain one of a minute would require no less a length than 11,738 feet 4,800 inches; the first therefore, which would still be very limited as to any important correction in its effect, would be of a most inconvenient, and the latter of an impossible length. By adopting the mode of this patent however, it will be found that such, or even a greater extension of detachment than a minute is practicable without any difficulty or inconvenience whatever, and even in a smaller space than is required for the common seconds clock.

The next general advantage is, that a clock made on this principle of extreme detachment requires a much less first power than a common clock, for the power of the former may be organized so as to rest altogther for intervals of minutes, and to be limited when in action to less than half seconds, between those intervals, while that of the latter is constantly exerted every second; nevertheless, the maintaining power of the former need not have more to perform every minute than the other has every second. It follows, therefore, that a clock may be constructed on this principle to require only one-sixtieth of the weight or power of a common clock, or that with the same power it will go sixty times as long.

Again, the mode of extreme detachment by diminishing the quantity of the first force to so great a degree, and by the constant state of repose which it preserves in the train of the clock, removes almost entirely the strain and friction to which the works of a common clock are subject; so that the wear of the patent clock becomes next to nothing, and it can therefore scarcely ever require the application of oil, or get out of order.

So also this system of detachment will be found greatly to simplify the train; in fact, the greater the extent of the detachment, the more simple will it be, by working from minutes instead of seconds. Notwithstanding which, however, the seconds, or any less division of time, may be indicated with as much accuracy as in the more complicated train of the common time-piece.

Such then are the general advantages of this patent; and whether they be viewed with reference to the extent of the detachment or the diminution of the maintaining power required, the increase of time, the reduction of friction, and wear in the works, or the simplification of the train, I conceive that no farther discussion of the principles is necessary with those who are at all conversant with the principles of time-keeping, to convince them that the attainment of these points is of the utmost importance to the final perfection of a true measure of time. I shall therefore now proceed to the specification of the first plan which I have practised for their accomplishment; and here I have introduced a new modification of the action of gravity as applied to time-keeping, by taking as the time-measurer "a perfectly-detached body, descending freely down an inclined plane:" which modification, although it has never yet been applied to the measurement of time, is as immutable in its operations as the oscillations of a pendulum, and is in fact governed by the same law. The extreme detachment of which it is capable, and certain specific advantages, which the pendulum does not possess, have pointed it out to me as an important agent in the measurement of time.

The following are several different modes in which I have applied this new regulating organ for the accomplishment of this patent.

Figs. 1 and 2 (Plate I.) shew the dial and frame plate of an eight-day spring clock, having a small tube *a b*, six inches long, containing a steel ball. This tube and ball serve the purpose of a pendulum 7 feet 4,038 inches in length, making exactly forty beats in a minute. The tube is connected with the train merely by an arbor and pinion; and being a little inclined the ball runs from *a* to *b*, where it discharges, by striking against it, a small spring detent *d*, that holds the tube in the position *a b*, when being so discharged the tube makes a half revolution from *b* to *a*, and is caught again by the same detent. The ball being thus brought back to the upper end runs down again, and striking away the detent, repeats its half revolution as before. This tube may be in part considered as a revolving pendulum where the centre of gravity oscillates, but the system revolves; and where the time is measured partly by an oscillation, and partly by the descent of the ball down the plane.

The clock is at rest while the ball runs from *a* to *b*; that is two-thirds of the whole time; and a tube of six inches, thus producing beats as slow as a common pendulum 7 feet 4,038 inches in length, is consequently in that proportion so much less liable to the expansions or contractions of temperature. All the escapement-work also is here avoided; a common steel pinion being substituted for it, the effect of the escapement being produced by the descent of the ball. This property, peculiar to the new regulating organ here specified, is undoubtedly a very important one, from the great nicety required in the construction of escapements and the comparative simplicity of making a common pinion, which here answers all the purpose.

The time is regulated by the small hand at C, Figs. 1 and 2, which by moving the detent *d* higher or lower diminishes or increases the inclination of the tube, and with it the time of descent.

Fig. 3 is the face of a clock similar to Fig. 1, but having a small wheel *a b* instead of the tube, connected with the train by an axis and pinion as before. This wheel contains a series of inclined planes *a x y z u b*, which being held in a given position by a small spring detent *d*, as in the former case, the ball unlocks the wheel, and the time is regulated as above.

In this application six seconds are consumed in the running of the ball from *a* to *b*, and in the shifting of the wheel half round for a fresh run of the ball. This index, therefore, makes ten beats in a minute, or five whole revolutions; and the wheel occupying not more than half a second in shifting, the first mover and train are at rest eleven-twelfths of the whole time; during which proportion of time the regulating organ is entirely detached from the maintaining power, and thus in a clock, not larger than a small table clock, the detachment is carried to as great an extent as by means of the best detached escapement hitherto made it could be with a common pendulum of 116 feet 8,608 inches in length.

Fig. 4 is a clock in which the detachment is carried to a still greater extent.

a b, Fig. 4, is an inclined plane, fourteen inches long and eight inches wide, having thirty grooves cut in it, as shewn in plan Fig. 5. Along these grooves a small ball runs from *a* to *b*, or from *c* to *d*, according as the plane is inclined one way or the other. Now this plane is calculated at a certain inclination to give exactly one minute for the time of the ball's motion from one end of it to the other, where, having arrived at the lowest point, it strikes a lever *n*, connected with the detent *e*, and unlocking it, the maintaining power is allowed to act for a moment for the purpose of shifting the plane (which is most accurately balanced on a knife-edge) into the position *c d*, that the ball may run back again in another minute to the opposite extremity of the plane, where it again unlocks the same detent by a corresponding lever *m* connected with it. The velocity of the ball is no greater at the bottom of the plane than at the end of the first groove, for the acceleration required in each groove is destroyed by the small brass deflectors *s s s s*, &c. Fig. 5, at the end of each groove, which turn the ball into the opposite direction of each succeeding groove; neither is the ball allowed to stop the least instant of time during the shifting of the plane, but is immediately thrown back on its return by the action of a small crooked arm, so regulated, by its form and pressure ware as instantly upon the ball's striking the lever to throw it back, and keep it moving on its return until the shifting of the plane is completed, with the mean velocity of its motion on the plane when so shifted; so that no inequality produced by the first power in the time of the plane's shifting can make any variation in the whole time of the ball's motion from one end of the plane to the other; for, whether the plane rises faster or slower, the ball always returns at the same rate without a moment's pause.

This correction is, indeed, almost superfluous; for in the very short and rare action of the maintaining power, during the almost instantaneous shifting of the plane once a minute only, any inequality that can possibly arise with ordinary good workmanship must be next to nothing, and can hardly produce a sensible effect in the longest period of going. It shews, however, that the principle of extreme detachment may in this application be made absolutely perfect, inasmuch as neither the motion of the ball in its progress along the plane, nor at the moment of its departure on its return, is in the least influenced by the first mover. The time of shifting the plane is not so much as half a second; therefore the first power of this clock is at rest, and the whole train in a state of repose more than one hundred and nineteen hundred and twentieths of the whole minute; that is to say, all connection with the moving power is as long suspended as could be effected on the ordinary principle of detachment with a pendulum of the enormous and impossible length of 11,738 feet 4,800 inches, which if it were practicable would vibrate minutes. Yet, notwithstanding this extreme detachment in the patent clock, the smallest portion of the intermediate time, may be indicated by the beats of the ball or time-measurer; which, as stated at the commencement of this specification, is the great characteristic of this new mode of detachment. This is effected by a bridge or bridges, &c. *ff*, across the plane, under the arches of which the ball passes. The figures indicating the division of time thus shewn are made to shift according as the ball runs from right to left, or from left to right, so that they may always be read the way the ball moves; thus the time may be read off in seconds, or smaller divisions, with the greatest accuracy as the motion of the ball is nearly uniform, all acceleration in passing down the plane being destroyed, as already described, at the end of each groove.

To explain the remaining parts of this clock—the circle M shews the minutes, advancing one every time the plane shifts, and the minutes being driven directly from the moving power P. The circle H shews the hours which are driven from M. R is the regulator, being the means of connection between M the minute hand and the plane, which is effected by a crank and rod *x y*. Every time, therefore, the ball unlocks the plane, R is allowed to make half a revolution, which gives the time to both minute and hour hands; the circle R therefore is graduated, and has a hand which adjusts the distance of the crank from the centre of the circle, by which adjustment the inclination of the plane is varied, and with it the time.

Thus in the space of a moderately-sized table-clock a time-piece is constructed, the vibrations of the regulating organ of which are as slow as those of a pendulum 11,738 feet 4,800 inches in length, by which the first power is so reserved that the weight or spring of a common eight-day clock may be made to carry it 480 days; neither is there any friction or motion in its train for one hundred and nineteen hundred and twentieths of the whole time of its going, while the train itself is also considerably more simple than that of a common seconds clock.

It is evident there are innumerable varieties of configuration in the application of this principle, which it is impossible to specify or even to anticipate, but which must nevertheless be integral parts of this invention, if they in any shape accomplish the mode of measuring time by means of the extreme detachment here specified.

To attain this, therefore, it cannot be lawful for any one to make use of any body, whether spherical, cylindrical, or conical, moving on any inclined plane, however the same may be combined with any machinery or clock-work whatsoever; whether the plane be simple or complex, curvilinear or rectilinear; whether it vibrate or revolve; whether the body moving down it be a simple or a compound substance, consisting of one or more parts; whether it be a fluid or a solid, or a combination of both.

Various modes also may be introduced for the compensation of the expansions and contractions of temperature, either in the detent or in the rod *x y*, which it is not necessary here to specify; but it should be observed, that an inherent power of compensation is combined in the very principle itself, for as the plane expands so also does the ball, and *vice versâ;* the ball therefore moves quicker as its course is lengthened, and slower as it is shortened; because the vertical distance of the points of contact from the centre of gravity of the ball increases with the expansion, and decreases with the contraction of this ball and plane, so as to accelerate the motion of the ball in the first case, and retard it in the second. It appears, therefore, that this inherent property may, by a due proportioning of the diameter of the ball and the matter of which it is formed to the mean length of the plane and its component materials, be so adjusted as of itself to produce a perfect compensation.

And, lastly, with respect to the workmanship of clocks made on this principle, it appears that less attention to it is required than in common clocks; for as to the train, it has so little comparatively to perform, and so little of the measure of time has been shewn to depend upon it, that any want of superior workmanship must be little felt; and for ordinary purposes therefore even less than ordinary accuracy must be sufficient.

And as to the plane, as any inequality in the surface or irregularity in the first formation of the grooves must always similarly recur to the ball in every descent, it follows that no such circumstances can destroy its true measure of time; but should any change in the surface of the plane or in the form of the ball take place in a length of time, such change must be for the better, since the edges of the grooves will become more and more even and polished as the ball travels; and the ball will wear itself into the most perfect sphericity, as from its rolling over at the extremity of each groove by means of the deflectors *z z z*, Fig. 5, its axis of motion is constantly varying; it appears, therefore, that no part of the truth of the action of such a clock depends, as is the case with the present system of good timekeepers, upon the exquisite perfection of their workmanship;

manship; neither does it depend upon any particularly nice adjustment or preservation of position, for although the clock be placed out of the true level, so that the plane in shifting becomes more inclined one way than the other, still it will be found that what the ball has gained one way it will exactly lose the other, and that therefore the result of every two librations of the plane must (in any position in which the ball will continue its motion both ways) be the true measure of the sum of any two consequent periods of its course, a principle of self correction which does not exist in common pendulum clocks.

The next application of this new modification of the power of gravity for the measurement of time which I propose to specify, is that in which *two balls* are used instead of *one*, as in the cases hitherto explained.

A B C, Fig. 6, is a wheel attached to the train of the clock by an axis and pinion similar to that in Fig. 3, having three tubes A B, B C, and C A, and two balls.

Suppose the two balls at 1 and 2, then will the wheel oscillate slowly till the balls are brought nearly into the position 2 and 3 by the simple operation of gravity; and suppose that at this period the first mover is allowed to act for an instant to throw the wheel a little farther round, so that the upper tube becomes in a small degree inclined, the ball will then run to the other extremity so as to restore the first position 1 and 2, which change will immediately produce another slow and detached movement of the wheel nearly one-third round; and this being completed as before, the first position will be again assumed. This variation, therefore, though depending upon the action of two balls instead of one, must be considered as another integral part of this patent;

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patent; not only because it acts by a similar process, but because it produces the same effect.

It cannot therefore be lawful for any one to construct a clock, the time-measurer or regulating organ of which shall be constituted by means of this, or any similar application of *two*, or any *greater* number of balls, whether they act by partial revolution or oscillation, or however they may be connected with each other or with the train.

And it is evident that no possible application of the descent of any body or bodies, fluid or compound, down an inclined plane, can be made for the purpose of measuring time, or of procuring the system here specified, of extreme detachment between the regulating organ of clocks and chronometers, and their maintaining power, which must not be a violation of this patent.

I shall now, therefore, proceed to specify the mode by which I accomplish precisely the same system of measuring time by the simple pendulum; that is to say, where, agreeably to the characteristic distinction which pervades this patent, the duration of the detachment shall not, as by the present system, be limited to the times of vibration; but, on the contrary, let a pendulum vibrate half seconds, quarter seconds, or any the smallest portion of time, still, like the ball on the inclined plane, it shall be absolutely detached from the first mover for any number of these portions, as a minute, or any number of minutes, and this also without the intervention of any auxiliary power.

A, Fig. 7, is a light swing-wheel, with thirty teeth, unconnected with every thing but the seconds hand and the small pair of pallets X Y, which by an inverted action drive the wheel.

B B is a larger swing wheel, having sixty teeth, connected with a single pallet P, on the same stock as those X Y, P being driven by the wheel B B.

C a wheel of sixty teeth, on the same arbor as B, being the last wheel of the train, or effected, if preferred, by sixty steel pins on the face of B.

E F a lever, locking the wheels C and B by the pressure of the spring S, except when discharged by the pin P on the face of A.

D centre of suspension of the pendulum.

Now suppose the wheels C and B locked by E F in such a position that the pallet P works within the teeth of B without touching either way, and suppose a seconds pendulum set in action under these circumstances, then will the force of oscillation given to it drive the small wheel round by means of the pallets X Y, with a dead-beat, indicating seconds at every vibration, so as to make the seconds hand revolve once in sixty seconds. At the sixtieth second the pin P will come in contact with the lever E F, and unlock B, which has remained in a state of repose for fifty-nine seconds, during which time the pallet P has had no connection with the swing wheel B, and the pendulum has vibrated perfectly free and detached from the moving power. On being unlocked, however, as above described, the wheel B starts forward by the action of the first mover, and encountering the pallet P, gives it an impulse regulated to restore the oscillating power lost by the pendulum during the fifty-nine vibrations of seconds. At the end of the sixtieth second, however, the pin P has escaped the lever E F, and the wheels C and B are again locked so as to allow of fifty-nine more free vibrations of the pendulum,

dulum, until the pin P comes round at the sixtieth second to release them again.

Thus, then, there is obtained by the common pendulum a perfect and extreme detachment for fifty-nine seconds of the minute; and it is evident that the principle may be extended, by increasing the numbers to any greater degree, within the limits of the inherent and detached oscillating force of which the pendulum can be made capable, without increasing the time of the oscillation, and also without introducing any auxiliary force between the first mover and the regulator, contrary, as before stated, to the properties of every escapement yet applied.

I shall now, therefore, compare the advantages of this mode with the present system of detached escapements.

In the first place, the description of its action shews how much more the detachment is extended, and how much more the pendulum, as the regulating organ, is in this case left to the pure and unmixed action of gravity. In no escapement hitherto constructed has the pendulum a perfect freedom of oscillation, even for a single second, without having at some given point or other to unlock some detent, or perform some similar operation, which immediately brings upon it a controuling power in a direction contrary to its spontaneous effort, or an accelerating power to urge it forward; and which, from the infinite nicety of application required, must, from its constant interference, continually tend to affect the isochronism of the pendulum.

Here, on the contrary, for fifty-nine seconds the gravity of the pendulum is the sole and uncontrouled cause of its motion, having its arcs of vibration neither lengthened nor shortened by any urging or opposing cause, for the mere driving of the light and perfectly free seconds hand, constant, uniform, equally poised, and opposing no limit to the arcs of vibration, can be considered as nothing but a small increase of friction on the point of suspension, until the sixtieth second, when it has to unlock the detent, and when at the same instant it receives a fresh supply of force, left, however, to operate as freely as before in the production of its effect upon fifty-nine out of sixty of the subsequent oscillations of the pendulum.

In the second place, it will be found that considerably less first power is required to keep the same pendulum in action for a given time by this mode; because one great impulse will be found to be given with much less absolute friction than the sum of a great number of small forces, even if they amount to the same impulse, for as many parts (or even more) of the train are in motion, and in as much motion each to produce the lesser impulse as the greater one; and therefore in giving the one united impulse there is no more friction than in giving each of the sixty lesser ones; that is to say, the friction in applying the requisite maintaining power, on this principle, is only one-sixtieth of what it is in the ordinary mode.

But this is not all; for a pendulum thus allowed to act freely would maintain the force of vibration first given it for a much longer time, and with much less variation in its arcs of oscillation, than when coming constantly in contact with machinery, supposing no first power given; therefore, although that machinery may constantly impart to the pendulum fresh increments of force, still in so doing, it follows that by the very contact of machinery necessary for imparting this new force, a certain part of the inherent force at the time of contact is destroyed at every such contact, which, were it not so acted upon, would continue with little variation for considerable periods. To withhold this contact as long as possible is therefore a direct saving of all this force for the time of such detachment, nor is there more of this inherent force destroyed in the contact necessary to give the one impulse every minute (or whatever the period may be) than would be lost in giving the divided impulses of each second, for the power required to unlock the detent in the one individual action at the end of the minute, is no more than in the other individual action at the ends of each second; nor is the friction in the one individual action of the pallets at the end of the minute more than in the other individual action at the end of each second. Here then is a saving of the inherent force of the pendulum in a ratio of fifty-nine to one, to be added to the saving of friction above stated, to be also in that same ratio. Now these will be found to be the principal causes of that loss of motion in the vibrations of pendulums which is to be restored by the first power; for the remaining causes of its loss of motion are but the friction on the point of suspension and the resistance of the air. On these two there certainly will be always an increase of effort required in the impulse of the maintaining power, in the direct proportion of the length of time they are allowed to accumulate. But as these latter are extremely trifling compared to the other two causes of the loss of power above mentioned, in which there is an absolute gain of fifty-nine to one, it follows, that although the saving of power on the whole will not be exactly as fifty-nine to one, still it will be nearly so. To calculate it exactly is not perhaps possible, because it is difficult to say what the proportion of the friction of the point of suspension in the pendulum is to that of the whole work, and indeed it may not be the same in any two clocks, but is evidently, under any circumstances, an extremely small part of the whole.

In the third place, this application of the system of extreme detachment has all the advantages of increasing the time of repose, as to the wear of the works, in common with the inclined plane regulator, but it is of enhanced importance with reference to the escapement; for as in this case the swing wheel B and the pallet P, Fig. 7, by which the force is imparted to the pendulum, are only in contact once in a minute, a relief is thus afforded to this most delicate and important part of the works, not accomplished by any escapement hitherto constructed.

So also is the train in like manner simplified; for the two swing wheels A and B are here the indicators of seconds and minutes, though both are connected immediately with the pendulum; that is, A revolves once in a minute, and B once in an hour, without any intermediate train. Hence arises a great additional saving of friction and work; for an eight-day clock requires only one pinion with the ordinary numbers and an extremely small power, and a year clock may be made with only two pinions with the ordinary numbers of an eight-day clock, and with very little more power.

It is evident that this mode of escapement is in every respect above specified, and with similar advantages as applicable to the vibrations of the balance-wheel of watches and chronometers as to the oscillations of the pendulum, with the exception only as to the duration of the period of detachment, inasmuch as the balance-wheel cannot be given the same independent power of vibration from its spring which the pendulum possesses from its own gravity. The balance-wheel may, however, in the same way be as absolutely detached beyond the ordinary limits of its individual vibrations for five or ten of those vibrations, or perhaps for a considerably greater number, by increasing the weight of the balance in proportion to the strength of the spring, and therefore with proportionate savings of power, friction, and the other advantages belonging to this system of extreme detachment. With regard to the actual mode of application, it is in fact so precisely the same as to machinery as well as effect, that it is needless to recapitulate it in the specification, with the mere substitution of the terms balance-wheel for pendulum, &c. &c. and with the difference in the numbers, depending on the different extent of the detachment; for any farther specification of it would obviously be but a recapitulation of this kind.

It is certain also that in this movement, whether applied to clocks or watches, there may be various configurations by which the same effect may be produced; still, however, as to produce these same results they can only be constructed after the mode of extreme detachment, and with the distinct and characteristic properties of that detachment, as above specified to be the basis of this patent, they must be considered as integral parts of it. It cannot, therefore, be lawful for any one to attempt, by means of the double pallets and swing-wheels here specified, or by any other system of machinery producing the same effect, to detach any pendulum or balance-wheel from the first mover of a clock for any greater period than that limited by the individual vibrations of the pendulum or balance-wheel; for such is the spirit of the detached escapement here specified and secured; that is to say, that a detachment is here effected with a common seconds pendulum, or with the common balance-wheel, which would on the ordinary construction of escapements require enormous and impossible lengths of pendulums or diameters of balance-wheels: so that it cannot but be contrary to the spirit of this patent to apply any machinery, which shall give this power of extreme detachment to any pendulum or balance-wheel of less dimensions than would give such detachment according to the ordinary principles. It remains only to be added, that this system of detachment, as relating to the construction of clocks, is to be somewhat extended by the use of a compound instead of a simple pendulum. And although this cannot in practice be extended to any great degree, because to increase the times of vibration materially, and at the same time to maintain sufficient vigour of oscillation to produce any long continuance of vibration, this compound must, as well as the simple pendulum, though not in an equal degree, be made of very inconvenient dimensions; still it may be applied so as to double some of the effects herein set forth. Such application of the compound pendulum therefore, as being a mode here specified of extending the system of extreme detachment, which is the basis of this patent, must be considered as an integral part thereof; so that it cannot therefore

Fig. 8.

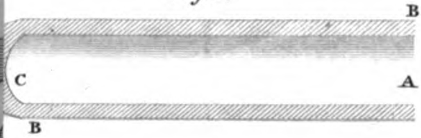
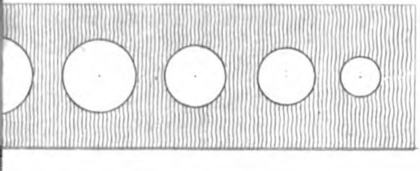


Fig. 9.



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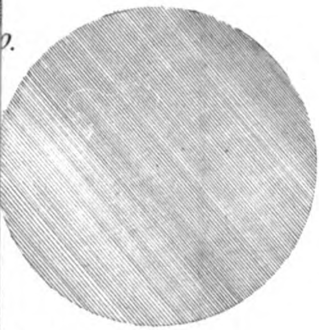

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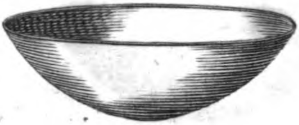
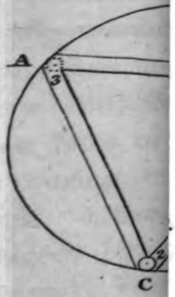
Fig. 11.





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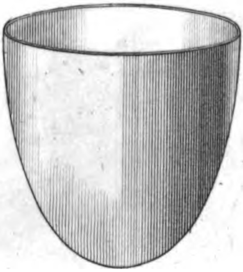

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therefore be lawful for any one to make use of a compound pendulum consisting of two or more bobs, by the means of any machinery whatsoever, for any combination or assimilation with the system of extreme detachment herein specified and declared.

In witness whereof, &c.

Specification of the Patent granted to BENJAMIN COOK, *of Birmingham, in the County of Warwick, Manufacturer; for a Method of making Barrels for Fowling-Pieces, Muskets, Pistols, and other similar Fire-Arms; and Ram-Rods for the same.*

With Engravings.

Dated March 28, 1808.

TO all to whom these presents shall come, &c. NOW KNOW YE, that in compliance with the said proviso, I the said Benjamin Cook do hereby declare that my said invention of a method of making barrels for fowling-pieces, &c. is described and ascertained in the following manner; that is to say:

My first method is as follows. I take iron, steel, or other suitable metal, or mixture of metals, either cut from bars or forged, or cast, or otherwise made ready for boring or drilling into proper lengths, forms, and sizes. I then draw them out round, or of any shape desired, by passing them between rollers or under the hammer, and then cut them into such lengths or pieces as are suitable for the required purpose; which lengths or pieces I then fix in a lathe, or other proper machine, and drill, cut, or bore out the inside (by any of the means now in use for such purposes) through the whole or part of their length, as the case requires. But, in order that I may be more easily understood, I will suppose the piece or carcass drilled as in the figure in the margin. (See Fig. 8, Plate I.) A C the part so drilled or taken out, leaving the black lines B B on the outside as the thickness of the sides of the carcass. Now, if I only drill or cut out a core part of the way, instead of going through the whole length, I only go to C, leaving the end solid. I then draw or force the carcass through plates with holes graduated one size below another, (see Fig. 9,) until it is drawn out the full length desired; or I pass the carcass through rollers with grooves in them, until it is brought to the length and form required.

My second method is to take plates or scalps of iron or steel, drawn under the hammer, or rolled or otherwise made to the proper size, form, and thickness, which I turn over a maundrel, beak iron, or any thing suitable for the purpose, and weld them. I then draw or force them through holes, or plates with graduated holes, as above; or I pass them between rollers with grooves in them, as before specified, until they have attained the length, size, form, and thickness desired.

My third method. I take round or other shaped plates of iron, steel, or other proper metal or mixture of metals. I will suppose a round plate, Fig. 10, and one-sixteenth of an inch thick, or less or more. This plate being forced through a hole smaller than its own size, takes a concave form as in Fig. 11 in the Plate; and as it passes through holes of smaller dimensions, approached (see Fig. 12) and at length assumes a tube form, the form required. I then continue to force it through holes, or I pass it through rollers or plates as before specified, until it has attained the size and length required. Now, as I before supposed, the plates are one-sixteenth of an inch in thickness before they begin to pass through holes, and as they increase in length by passing through smaller and smaller holes the sides of the tubes increase in thickness; so that in either of the methods before described, if the carcass passes from six inches in length to four feet in length, and was only one-sixteenth of an inch, or thereabouts, in thickness when it first began to pass the plates or holes, it will by the time it is four feet, or thereabouts, have attained nearly or about four times the thickness, the diameter of the tube being gradually diminished. Barrels for cannon are made by any of the foregoing methods, only requiring machinery proportionably stronger. The slightest observation will fix upon the mind the great advantage of these methods in the manufacturing of fire-arms; the sides of the barrels will of necessity be of equal thickness throughout; there can be little or no irregularity in any of the surfaces, inside or outside. In some cases it will be necessary to keep a bar in the barrels while they are rolled, drawn, or forced, especially in cases where barrels are required to be made of an octagonal or other form in the bores or holes; then a bar must be kept in the inside of the barrel, and as the barrel lengthens by rolling, drawing, &c. it takes the form of the bar in the inside. I make barrels also with a bar in the inside while it passes the rolls with one or more straight ribs or flutes in the bore, by keeping a bar so shaped in the inside while either rolling, drawing, or forcing, whether hot or cold. It will leave in the bore or hole of the barrel the shape of the ribs sunk in the inside of the barrel, which said barrel may be, if required, twisted for rifle barrels.

Barrels made by these methods have this very great advantage: there can be few or no unsound places in them. In two of the methods there is no welding. They can seldom if ever be burst; at least I should suppose not one in five hundred, for the very process so compresses the metal, and the several times they are annealed so toughens them, that they become of the nature of wire. They may be made considerably lighter, perhaps one-third, or even more than that, than those now in use, and also much stronger; and if in any case weight is desirable, they may of course be made quite as heavy as those now made. For all kinds of service, but especially for the India service, I do conceive that if the barrels can be made to stand the proof required, and yet be one-third lighter, or nearly that, they will be found to possess incalculable advantages.

By these methods of manufactory it is hardly possible that there can be one place in the barrel thicker than another, as is always the case in welded or forged barrels: they will of course act with more precision, and I presume with a much greater effect.

I do not conceive it necessary to specify the different machinery requisite to work the rollers, presses, or draw plates, the means are well known, and form no part of my invention; but it must be clear to every one conversant in mechanics, that powerful machinery will be requred either to roll draw or force, and when put in motion by steam or any other power, the process will be regular and rapid, so that I apprehend a musket-barrel will be drawn or rolled from its carcass to its full length in about one and a half or two minutes.

I draw, roll, or force the carcasses either in a hot or cold state, as I find most suitable for the purposes for which they are intended; either way will do, but if worked cold it will be necessary to anneal them often.

My method of making ramrods is simply to draw them as wire is drawn, or pass them through grooved rollers, from round, square, or any other shaped iron, steel, or other suitable metal, or mixture of metals; and either leaving the thick end of the strength required, by not entirely drawing the ramrod quite through the plate, or else draw or roll them of one size throughout, and attach the thick head or button to them afterwards by screwing it on the top, and riveting it, brazing it, or otherwise fastening it. If I make them in iron I harden them in the usual way, and afterwards temper them down till found sufficiently elastic. It will be observed, that ram-rods made by these methods require no filing or grinding, as they leave the plates or rollers perfectly smooth and regular.

In witness whereof, &c.

Specification of the Patent granted to JOHN CURR, *of Belle-vue-House, in the Parish of Sheffield, in the County of York, Gentleman; for a Method of applying flat Ropes, flat Bands, or Belts of any kind, to Capstans and Windlasses of Ships and Vessels, in, out of, or about Ports, Harbours, Rivers, Seas, or Creeks; and also for a Method of applying flat or round Ropes, Lines, Bands, or Belts, for the Purpose of catching and detaining Whales.*

With a Plate.

Dated July 30, 1808.

TO all to whom these presents shall come, &c. NOW KNOW YE, that, in compliance with the said proviso, I the said John Curr do hereby declare that my said invention is described in the manner following; that is to say: My method of applying flat ropes, flat bands, or belts of any kind, to ships or vessels to tow or convey in or out of harbours, rivers, seas, or creeks, is as follows. The flat rope, flat band or belt, is attached to the capstan, so that it can easily be taken off when required, or by having a splice may be disunited within a few yards of the end, which will be more convenient, and may be wound and lapped upon itself; or if it is more convenient may be wound upon the capstan, in two or more tiers, in the same manner as a flat cable is wound upon a windlass, as is particularly described in the specification of a patent granted to me by his present Majesty King George the Third, dated at Westminster on or about the fourth day of July, one thousand eight hundred and six; in which case it may not be necessary to apply multiplying wheels to work it; but if the flat rope, flat band, or belt, be wound in one tier only, in order to give sufficient power to the sailors to heave the ship forward when the flat rope, flat band, or belt, has increased in diameter, it will be proper to fix a large tooth wheel on the capstan axletree, about equal in diameter to the greatest extent the flat rope, flat band, or belt, will extend to, which may be worked by a small nut wheel, or nut wheels, of convenient dimensions; and two flat ropes, flat bands, or belts, or more, may be applied on the same capstan, as will hereinafter be described. One flat rope, flat band, or belt, or more, may be applied on the same capstan, but the annexed drawings shew a commodious manner of working two flat ropes, flat bands, or belts, upon one capstan; where Fig. 1 (Plate II.) shews a platform, and Fig. 2 an elevation of the capstan. *a* represents a large tooth wheel fixed on the capstan axletree, and *b* a moveable wheel, which, having a circular centre, will turn round without moving the capstan axletree *h*, or capstan drum *e*. *c* a nut wheel, which turns the tooth wheel *a*, and which by raising the gudgeon *d*, and fixing a proper block under the collar *k*, may be applied to turn the cog-wheel *h*; by which method either of the two flat ropes, flat bands, or belts, may be worked separately by the drum-head *g*, one flat rope, flat band, or belt, being wound upon the drum *e*, and the other upon the drum *i*; and if it be required to work a round rope upon the drum-head *g*, it may be done by raising the gudgeon *d*, and the part connected with it, so that the nut wheel *c* may be clear of both tooth wheels, and placing a block under the collar *k* of the axletree or gudgeon *d* of a proper thickness. Each flat rope, flat band, or belt, will require a leading roller or rollers to guide it both from the stem and stern of the ship in a fair direction to the capstan;

and may then be conveyed by another roller or rollers in any direction required; and palls or other stops must be applied to the tooth wheels, to hold them in any situation required. The nut wheel *c* should be fixed about the centre of the vessel, which allows room for a sufficient length of capstan bars, and gives room to the sailors to apply their powers to the greatest advantage. For the convenience of sending out a guess line, or for other purposes, it may be proper to have the flat rope, flat band, or belt, divided into two or more parts, and so connected together by splices that it may easily be disunited. The tooth wheel above described is fixed horizontally, but may be fixed to work in any other position more suitable and convenient. If the flat rope, flat band, or belt, is applied to a windlass, it must lap upon itself, and be used as directed as above for the capstan.

The advantages of my invention of towing ships and vessels consist in saving the labour of the men, in expedition, and preventing the ship's decks being so much incumbered with ropes.

My method of applying flat or round ropes, lines, bands, or belts, for the purpose of catching and detaining whales, is as follows. The annexed drawing, Fig. 3, is a plan of a whale-boat, in which *o* represents the reel, *p* the break, and *q* the break lever, which being pressed down presses the break *p* upon the break rim *t*, and thereby resists in some degree the action of the whale. *r* the guide and stop for the whale line, the use of which is farther explained afterwards; *s s* the whale line; *u u* rollers to keep the line near the centre of the boat.

Fig. 4 shews a side view of the whale-boat and apparatus, and Fig. 5 a section of the same; the letters of which on each figure correspond with those marked upon Fig. 3. In Fig. 6 *r* shews a front view of the guide or stop, which works upon a pin or bolt *w*, and is fixed down by the cotter *x*; and *s* the whale line upon an enlarged scale. When a whale has nearly run out with the line of one boat, and it is necessary to join it to the line of another boat, having previously made a knot within a few yards of the end of the line so large that it cannot pass through the stop *r*, or having fixed a hoop or bulk of any kind on the line which will answer the same purpose as a knot, which knot or bulk being in contact with the stop *r*, the end of the line may then be taken and attached to the line of another boat: this being done, the cotter *x* may then be drawn out and the stop *r* raised up. The rope or line is then entirely disengaged from the first boat, and the management of the whale put in care of the second boat. The same means may be used to attach the lines to a third boat or more if required; or, instead of having a stop, as above described, the same purpose may be effected by having an upright or uprights of wood, or other fit material, fixed near the stem for the line to pass through, with a cotter to keep the line in its proper place, as shewn by Fig. 7, on an enlarged scale, or by making the uprights sufficiently high a cotter may not be necessary, and a screw or lever, or wedge, or other mechanical power, may be applied to press upon the rope to hold it fast without a knot; or it may be held fast by the men in the boat until it is connected with the line of another boat.

Having described one method of disengaging a line from a boat and attaching it to the line of another boat, I will now shew a method by which the same purpose may be effected while the whale continues to run the line out of the boat, which is to double the whale line for about twenty or twenty-five yards, more or less, and to connect the end of it slightly by a piece of packthread at *y*, Fig. 8. This being done, the line must then be wound upon the reel, beginning to lap on the part *z* first, which is fixed upon a small pin fixed in the axletree of the reel, so that when the single part of the line is all run off, the end of it, *y*, may then be disunited, and will wind off the reel, and may be taken to, and connected with, the line of another boat while the whale continues to run out with the line. When there are two or more reels in the boat the same method may be used to attach the lines of one reel to the lines of another. I recommend my patent whale-lines to be used, as they may be made much smaller than common ones, will be equally as strong, which enables a greater length of line to be wound in the same room, and the centre of the reel being fixed higher in the boat than appears in Fig. 4, a still greater length of line may be accommodated. As the lines in running out occasionally cut a nitch or hole in the ice, and in the usual way of knotting or fixing the ends together a bulk is made, which sometimes fastens in the nitch or hole, and either breaks the line or draws out the harpoon from the whale, I recommend a hollow conical fixture made of iron, or other fit matererial, (which will accommodate a knot within to fasten the rope,) as described by Fig. 9, which from its construction, together with its own gravity, will be inclined to throw itself out of the nitch or hole above mentioned.

The advantages of the above method of catching whales are as follows: First, the lines being wound upon reels, and passing safely from the reel to the head of the boat, are not subject to entangling as in the old way.

Secondly,

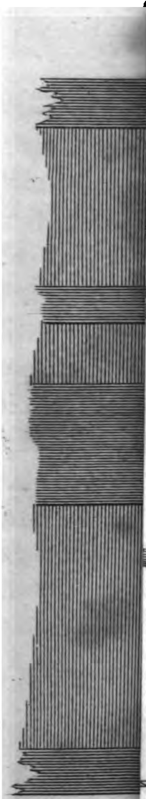


Fig. 2.

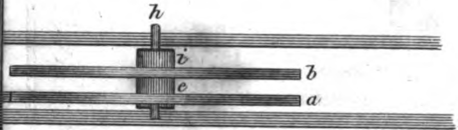


Fig. 5.

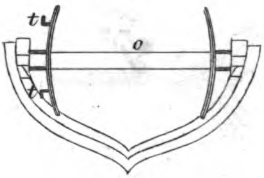
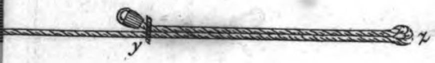
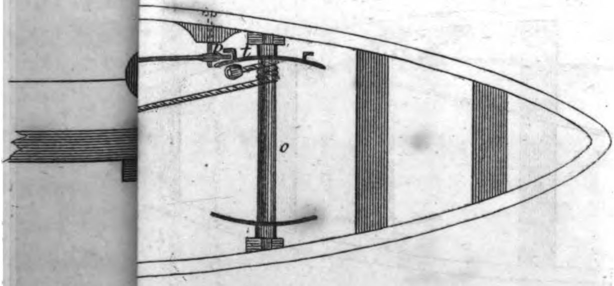
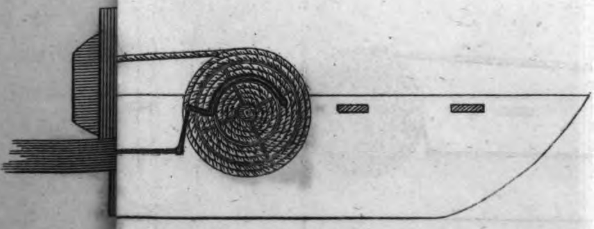


Fig. 8.







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Secondly, the lines in my method are not so subject to injury or to be quickly destroyed as they are in the old way by running round the bollard. Thirdly, in the old way the men's hands are frequently inflamed by holding back the whale-line. By the break or lever employed in my method the speed of the whale may be effectually retarded without danger or difficulty by the harpooner, or other person appointed. Fourthly, in my method the line is confined in the centre and stern of the boat, and will therefore prevent the danger and inconvenience to the men that would ensue if it was at liberty; and, fifthly, by making a boat large enough to accommodate two reels and a sufficient quantity of lines, fewer boats and a smaller number of men will be required to man a whale-ship.

In witness whereof, &c.

Specification of the Patent granted to WILLIAM BELL, *of Birmingham, in the County of Warwick, Engineer; for an Improvement in making Pipes or Pumps for conducting Water and other Liquids.*

Dated April 30, 1808.

TO all to whom these presents shall come, &c. NOW KNOW YE, that in compliance with the said proviso, I the said William Bell do describe and ascertain the nature of my said improvement in manner following; that is to say: It has been found, by long experience, that pumps or pipes for conducting water from water-works which have been made of wood, or iron, lead, or any other metallic substances, have been justly objected to, for the various following reasons.

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First. Pumps or pipes which are made of wood are liable to constant decay, and in a short time to become rotten: and it is invariably the case that in their rotten or decayed parts they generate insects and vast numbers of noxious animalculæ, which may always be discovered in water which passes through wood pipes or pumps which have been some time in use; and Dr. Buchan observes, that "waters become putrid by the corruption of animal and vegetable bodies with which they abound." Water which is conducted through pumps or pipes which are made of iron, lead, copper, or most other metallic bodies, becomes impregnated with the corrosive qualities of the metals which renders it unwholesome and poisonous, and of course unfit for cooking or washing linen, and many other domestic uses. The nature of my improvement is, therefore, to remove the aforesaid objections, which I completely perform by making tubes of porcelain pottery, and various compositions which are vitrifiable, and are not liable to corrosion or decay. These tubes are formed in such a way at the ends as to fit one within the other, which I connect or unite together by cement, so as to make them water or air tight. And by the addition of any number of these tubes, connected as aforesaid, I form one complete tube or pipe to any extent which may be required. I prefer the method of inclosing them in cast-iron pipes or cases, which are to be made in various ways and forms; which pipes or cases serve as defenders of these porcelain or pottery tubes, to prevent breaking or bursting. Cases or pipes may be made of wood, and various other substances, for inclosing these porcelain or pottery tubes or pipes; but, for the sake of compactness, strength, and durability, I recommend cast-iron

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cases, boxes, or pipes. There are compound metals which are less corrosive than the real metals as aforesaid of which tubes may be made, and if inclosed in the manner before described would be useful in conducting water and various liquids, either hot or cold, for particular purposes; as also thin tubes, made of wood, which may be prepared for durability by boiling it, or burning or charring it, which has the effect of preventing its breeding or harbouring insects, &c. These, in addition to my porcelain or pottery tubes inclosed, I claim the originality of.

In witness whereof, &c.

On the Culture of broad-leaved Clover (Trifolium Pratense) *by the Tullian Method.*

Communicated by Mr. Bartley *in a Letter to the Editors.*

Gentlemen,

For many years past I have adopted the *Tullian method* in raising potatoes and some other articles of general culture, *i. e. in rows of three feet interval; without manure; pulverising the soil and eradicating weeds in the intervals with the hand-hoe, and opportunely drawing the earth of the intervals to the roots of the growing plants.*

On this scale of management I have repeatedly made experiments with broad-leaved clover and lucerne, the former (as Curtis, in his book on the British Grasses, remarks) being "most undoubtedly a perennial." Viewing the constant results of these experiments, I had no reason to doubt its superiority by comparison with the broad-cast method of sowing clover seed.

I recol-

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I recollect that in one of those experiments was obtained, *in two cuttings*, at the rate of more than five loads prime clover hay *per* acre.

But my principal motive in addressing you at this time is, to communicate an experiment recently made on the same subject in which I have endeavoured to be accurate.

On the third of June 1807 I sowed several three-feet rows with broad-leaved clover seed, which produced a fair crop in full bloom, as well as a partial crop subsequently, the same season, leaving the plants in a state uncommonly vigorous during the following winter.

On 24th June * last 1st cutting produced	19 loads *per* acre.
On 7th August	9
On 1st October	7
	35 loads of green clover *per* acre.

On former occasions I had ascertained that in the action of exudation or drying, green clover would lose about three-fourths of its original weight; assuming therefore that one-fourth of this weight would remain in sound marketable hay, the product would be about eight loads and a half *per* acre.

In the broad-cast way, and under such favourable circumstances, I imagine that about 5 loads *per* acre would be taken for a very stout crop; and 5 loads are more than I recollect to have seen produced in that way.

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* The crop was in a fit state, and ought to have been cut the latter end of May; the proper time elapsed, expecting a visit from an agricultural gentleman, who was prevented by his parliamentary avocations.

I beg leave to add, that I have an experiment in progress, comparatively with lucerne and clover, both sown last autumn, which on some future occasion I may crave your permission to detail. In its present stage, the weight of the clover to that of the lucerne appears to be as 19 to 14.

I am, Gentlemen, yours, &c.

Oct. 25, 1808. NEHEMIAH BARTLEY.

A Statement of the Capacities and principal Dimensions of His Majesty's Ships Hibernia and Caledonia, of 120 Guns each.

Communicated in a Letter to the Editors.

GENTLEMEN,

THE Caledonia of 120 guns, now carrying the flag of Lord Gambier, commander in chief of the Channel fleet, is supposed to be the most perfect ship ever built in England, as she is found to possess every good quality desirable in a ship of war. I have therefore transmitted you the following comparative statement of the capacities and principal dimensions of that ship and the Hibernia of the same force, which was made with the greatest care by the officers in the surveyors department at the Navy Office, and may be depended upon as authentic, and considered as a valuable document for ship-builders as well as for sea-officers.

I am yours, &c.

R. N.

	Hibernia.		Caledonia.	
Length	201	02	205	0
Breadth	53	0	53	6
Depth of hold (*a*)	22	4	23	2
Hanging of the gun-deck	2	3½	1	8
Depth of keels { main	1	8½	1	8½
Depth of keels { false	1	1	1	0
Height from the upper side of the main keel to the lower cill of the midship port	26	11½	27	9½
Mean draft of water when launched, excluding the effect of ballast on board, or the difference of the false keels	(*b*) 17	2	17	0
Draft of water when completed to five months { aft.	25	9	26	0
Draft of water when completed to five months { for.	25	7	24	10
Broke from the sheer when { launched	0	3	0	2½
Broke from the sheer when { loaded	0	7	0	5
Lower cill of midship port above water when complete	4	8	5	6
Displacement of water by the inch, at a height of 14 feet 5 inches from the upper side of the keel	Tons. 20	15/35	Tons. 20	16/35
Displacement, &c. at 22 feet 3½ inches, &c. as above	23	11/35	23	12/35
Total displacement *per* plan at a height of 22 feet 3½ inches from the upper side of the main keel	Tons. 4647		Tons. 4557	
Quantity immersed at the extremes by ships' breaking from their sheer	(*c*) 54		39	
Entire displacement, or weight of the ship and all its contents when completed to 5 months	4701		4596	
Quantity displaced after launching until completed to 5 months	(*d*) 2140		2140	
Weight of the hull when launched	(*e*) 2561		2456	

(*a*) The Caledonia, by having 7½ inches less hanging to her gun deck, has the advantage of carrying her midship port so much higher above flotation with but little loss of stability; as the guns and decks are in toto raised but half that quantity; probably still less hanging or a straighter deck would be better, especially for all three-deckers.

(*b*) The Hibernia had 50 tons iron ballast on-board when launched, with an inch more false keel than the Caledonia, which latter ship had only 40 tons of iron ballast; the Hibernia's actual mean draft at launching was 17 feet 5½ inches; the Caledonia's actual mean draft at launching was 17 feet 2 inches.

(*c*) A third of the quantity due to an immersion of the ship the same number of inches the ship has broke from her sheer, when complete, is allowed for the displacement of water by the extremities: thus, by immersing the Hibernia 7 inches, she would displace 163 tons, a third of which quantity is added for the quantity immersed by her extremes.

(*d*) This is very near the truth; the displacement by the respective plans correspond very accurately with the computation of the quantities received.

(*e*) The method adopted for fastening the Caledonia's beams to her sides is in effect above 80 tons less in weight to her top side than the mode used for the same purpose in the Hibernia; and the timbering the top side is about six tons weight less in the Caledonia; these circumstances, with the ten inches more depth in hold, enables the Caledonia to carry her midship port 5 feet 6 inches, and is found sufficiently stiff under her canvas.

Account of a new-discovered Fact in Hydrostatics, and of an Application of it.

Communicated by Mr. JOHN WHITLEY BOSWELL, *in a Letter to the Editors.*

GENTLEMEN,

SEVERAL months ago, in considering the manner in which water rushes in to fill up a vacant space formed in its substance, it occured to me that it must rise with an accelerated velocity from the bottom of that space, which, if not counteracted by some other cause, would make it ascend above the natural level. This preventing cause I afterwards suspected to be the falling-in of water from the sides of the vacant space, on which the impulse of the ascending water was expended. For some time I could not think of any good method of putting this conjecture to the test of experiment; at last it seemed evident to me, that in a tube (so managed as to prevent the water from at first entering) immersed vertically for the greater part of its length, that the water, on suddenly being permitted to enter its lower aperture, would rise above the level of the rest in the containing vessel; as all lateral access of water was prevented by the sides of the tube from operating to retard its ascent. The experiment was immediately tried, and found to succeed exactly as I supposed; for *the water rose a full third of the length of the tube above the natural level.* Some reflections on the manner in which water fills up the track of a ship under sail has lately brought this fact again into remembrance, and I have tried the experiment several times with tubes of different lengths within this last month, and always with the same result.

I imagine there is a ratio of increase of the height to which water will rise in this manner to the increase of the depth of the tube: the experiments I have hitherto made at least indicate this. In a tube 2½ inches long, immersed an inch and a half, the water rose ¾ of an inch above the level; in a tube 5½ inches long, immersed 3½ inches, the water rose 2 inches; and in a tube 21½ inches long, the water rose 7½ inches above the level of that in a cask, in which it was immersed 14 inches deep.

All facts in natural philosophy are in themselves sufficiently estimable to deserve attention; but merit it more when the relations they may have to matters in which we are deeply interested are considered. The fact which I have recited may probably hereafter be applied to many other objects of utility; that application of it, however, which I shall now mention, seems of consequence enough in itself to make it worthy of some consideration.

Ships in their progress through the sea have their maximum of velocity for a given impulse regulated principally by the motion they communicate to the surrounding fluid, and by the ratio of the level of the water behind them to that before them: the depression of the water in the track of the ship, commonly called the ship's *wake*, has its degree governed chiefly by the formation of the hinder part of the ship, and I am prepared to prove that the ratio of the angle of inclination of the slope, from midship to the stern, to the depth of the ship's draft of water determines this degree; but to do so now would both extend this communication too much in length, and likewise anticipate the contents of a paper on this subject, which I have had laying by me some time, and intend hereafter, when I have sufficient leisure, to prepare for insertion in your valuable work. I shall only, therefore, state now, that the more readily and the more completely the water can be made to close at the stern-post, so as to leave the least possible wake, and make the level behind the ship most nearly equal to that at the head, the faster will the ship move forwards.

This slope at the hinder part of the ship, technically called its *run*, may be from the sides to the stern-post, from the bottom upwards to the counter, or compounded in various degrees of those two modes.

The hydrostatical fact recited may be well applied to determine which of these methods of forming the ship's run should have the preference, and, as appears to me, decidedly points out that it should be given to the second; for in this way the accelerated velocity of the water rising from the bottom of the ship's track will be least impeded by the lateral resistance of water pressing in from its sides; and it is evident, from the experiments mentioned, that water rushes more speedily from the bottom upwards to fill up a vacant space than in other directions, and consequently that a ship, whose run was sloped from the bottom upwards, would make much less wake than one which was sloped from the sides to the stern port, and would therefore move through the sea with greater velocity with a wind of a given force.

I am also inclined to think that it would increase the speed of the ship to prevent the water falling in sideways into its track by other means also, of which the best

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best appears to be, to bolt two projecting pieces like keels along the run at as great a distance from the vertical plane of the keel as possible, so as not to touch the sides of the vessel; those pieces should be parallel to each other and to the keel; and if they were extended forward beneath the bottom to where the rise of the bow commenced, so as to form two additional keels, the ship would be much the better for it as to strength, taking the ground safely, and in making less lee way. The projection proper for these pieces would depend on their distance from the vertical plane of the keel; the greater this distance the deeper should they be; for most vessels under 300 tons, I should conjecture, at a rough estimate, that it would be sufficient if 12 or 14 inches.

In trying the experiment with the tube, different methods may be used for stopping the water from entrance at the bottom, and suddenly admitting it afterwards: that which I adopted was simply a valve, formed by a projection at right angles from the bottom of a rod, on which a piece of soft leather was cemented. By pulling the rod with one hand while I held the tube with the other, the valve was pressed against its bottom, and was instantly disengaged by pushing the rod downwards. This latter motion should be performed with as much quickness as possible. The experiment may be also exhibited if the tube is short, by merely stopping the upper end with the tip of the finger; which, by confining the air, prevents the entrance of the water. If the water is coloured, its rise in the tube will be more conspicuous. I have found also that a small ball of cork of a size to pass freely through the tube, placed in it previous to the immersion, will shew the ascent of the water very clearly, particularly when managed so as to fall over the side of the tube when it has passed through it, which is easily effected.

I have now only to add, that if the fact which I have here described has been before published, it is entirely without my knowledge. I have the greater reason to believe it is new, because I can find nothing like it either in Desagulier's excellent compilation of experimental philosophy, or in the recent one of Dr. Young, which it is to be supposed contained all that was known on such subjects previous to the period of its publication.

I am, Gentlemen, your obedient servant,

JOHN WHITLEY BOSWELL.

Hydraulic Investigations, subservient to an intended Croonian Lecture on the Motion of the Blood.

By THOMAS YOUNG, *M. D. For. Sec. R. S.*

From the PHILOSOPHICAL TRANSACTIONS of the ROYAL SOCIETY of LONDON.

I. *Of the Friction and Discharge of Fluids running in Pipes, and of the Velocity of Rivers.*

HAVING lately fixed on the discussion of the nature of inflammation, for the subject of an academical exercise, I found it necessary to examine attentively the mechanical principles of the circulation of the blood, and to investigate minutely and comprehensively the motion of fluids in pipes, as affected by friction, the resistance occasioned by flexure, the laws of the propagation of an impulse through the fluid contained in an elastic tube, the magnitude of a pulsation in different parts of a conical vessel, and the effect of a contraction advancing progressively through the length of a given canal. The physiological application of the results of these enquiries I shall have the honour of laying before the Royal Society at a future time; but I have thought it advisable to communicate, in a separate paper, such conclusions as may be interesting to some persons who do not concern themselves with disquisitions of a physiological nature; and I imagine it may be as agreeable to the Society that they should be submitted at present to their consideration, as that they should be withheld until the time appointed for the delivery of the Croonian Lecture.

It has been observed by the late Professor Robinson, that the comparison of the Chevalier Dubuat's calculations with his experiments is in all respects extremely satisfactory; that it exhibits a beautiful specimen of the means of expressing the general result of an extensive series of observations in an analytical formula, and that it does honour to the penetration, skill, and address of Mr. Dubuat and of Mr. De St. Honoré, who assisted him in the construction of his expressions. I am by no means disposed to dissent from this encomium; and I agree with Professor Robinson, and with all other late authors on hydraulics, in applauding the unusually accurate coincidence between these theorems and the experiments from which they were deduced. But I have already taken the liberty of remarking, in my lecture on the history of hydraulics, that the form of these expressions is by no means so convenient for practice as it might have been rendered; and they are also liable to still greater objections in particular cases, since, when the pipe is extremely narrow, or extremely long, they become completely erroneous: for notwithstanding Mr. Dubuat seems to be of opinion, that a canal may have a finite inclination, and yet the water contained in it may remain perfectly at rest, and that no force can be sufficient to make water flow in any finite quantity through a tube less than one twenty-fifth of an inch in diameter, it can scarcely require an argument to shew that he is mistaken in both these respects. It was therefore necessary for my purpose to substitute for the formulæ of Mr. Dubuat others of a totally different nature; and I could follow Dubuat in nothing but in his general mode of considering a part of the pressure, or of the height of a given reservoir, as employed in overcoming the friction of the pipe through which the water flows out of it; a principle which, if not of his original invention, was certainly first reduced by him into a practical form. By comparing the experiments which he has collected with some of Gerstner and some of my own, I have ultimately discovered a formula, which appears to agree fully as well as Dubuat's, with the experiments from which his rules were deduced, which accords better with Gerstner's experiments, which extends to all the extreme cases with equal accuracy, which seems to represent more simply the actual operation of the forces concerned, and which is direct in its application to practice, without the necessity of any successive approximations.

I began by examining the velocities of the water discharged through pipes of a given diameter with different degrees of pressure; and I found that the friction could not be represented by any single power of the velocity, although it frequently approached to the proportion of that power of which the exponent is 1.8; but that it appeared to consist of two parts, the one varying simply as the velocity, the other as its square. The proportion of these parts to each other must, however, be considered as different in pipes of different diameters, the first part being less perceptible in very large pipes, or in rivers, but becoming greater than the second in very minute tubes, while the second also becomes greater, for each given portion of the internal surface of the pipe, as the diameter is diminished.

If we express, in the first place, all the measures in French inches, calling the height employed in overcoming the friction f, the velocity in a second v, the diameter of the pipe d, and its length l, we may make $f = a\frac{l}{d}v^2 + 2c\frac{l}{d}v$; for it is obvious that the friction must be directly as the length of the pipe; and since the pressure is proportional to the area of the section, and the surface producing the friction to its circumference or diameter, the relative magnitude of the friction must also be inversely as the diameter, or nearly so, as Dubuat has justly observed. We shall then find that a must be $.0000001\left(430 + \frac{75}{d} - \frac{1440}{d+12} - \frac{180}{d+\frac{1}{2}}\right)$, and $c =$ $.0000001\left(\frac{900dd}{dd+1000} + \frac{1}{\sqrt{d}}\left(1050 + \frac{12}{d} + \frac{.9}{dd}\right)\right)$. Hence it is easy to calculate the velocity for any given pipe or river, and with any given head of water. For the height required for producing the velocity, independently of friction, is, according to Dubuat, $\frac{v^2}{478}$, or rather, as it appears from almost all the experiments which I have compared, $\frac{v^2}{550}$; and the whole height h is therefore equal to $f + \frac{v^2}{550}$, or $h = \left(\frac{al}{d} + \frac{1}{550}\right) v^2 + \frac{2cl}{d} v$: and making $b = \frac{1}{al:d + .00182}$, and $e = \frac{bcl}{d}$, $v^2 + 2ev = bh$, whence $v = \sqrt{(bh + e^2)} - e$. In order to adapt this formula to the case of rivers, we must make l infinite; then b becomes $\frac{d}{al}$, and $bh = \frac{d}{a} \cdot \frac{h}{l} = \frac{ds}{a}$, s being the sine of the inclination, and d four times the hydraulic mean depth; and since e is here $= \frac{c}{a}$, $v = \frac{\sqrt{(ads + cc)} - c}{a}$, and in most rivers, v becomes nearly $\sqrt{(2000\, ds)}$.

In order to shew the agreement of these formulæ with the result of observation, I have extracted, as indiscriminately and impartially as possible, forty of the experiments made and collected by Dubuat; I have added to these some of Gerstner's, with a few of my own; and I have compared the results of these experiments with Dubuat's calculations, and with my own formulæ, in separate columns. There are six of Dubuat's experiments which he has rejected as irregular, apparently without any very sufficient reason, since he has accidentally mentioned that some of them were made with great care: I have therefore calculated the velocities for these experiments in both ways, and compared the results in a separate table.

Tabular

Tabular Comparison of Hydraulic Experiments.

Observer	*d.*	$\frac{1}{s}$	Superf. Veloc.	*v.*	Dub.	Log. ratio	Y.	Log. ratio.	a $.1^7\times$	c $.1^7\times$	√ 0000*d.*
DUBUAT.	262.5	35723	15.96	12.56 ?	10.53	.0776	11.10	.0537	424	952	11.1
	258.5	6413	31.77	26.63 ?	28.76	.033[illegible]	28.02	.0221	424	952	28.3
	92.4	21827	9.61	7.01 ?	8.38	.0775	8.14	0649	415	914	9.3
	75.6	27648	7.27	5.07 ?	6.55	.1112	6.27	.0923	415	887	7.5
	17.6	9288		5.70	5.86	.0120	5.97	.0291	376	465	6.1
	16.4	432		32.52	31.61	.0124	30.67	.0255	374	451	27.6
	11.7	1412		14.17	13.59	.0182	14.05	.0037	360	416	12.2
	9.9	427		22.37	24.37	.0372	24.41	.0379	355	414	21.7
	5.8	212		27.51	27.19	.0051	27.34	.0027	332	466	23.5

Observers.	*d.*	*l.*	*h.*	*v.*	Dub.	Log. ratio.	Y.	Log. ratio.	a $.1^7\times$	$.1^7\times$
COUPLET	18	43200	145.08	39.16	40.51	.0148	38.49	.0075	376	469
	5	84240	25.00	5.32	5.29	.0024	5.40	.0065	326	492
			16.75	4.13	4.23	.0103	4.21	.0083		
			5.58	2.01	2.25	.0490	2.01	.0000		
BOSSUT	2.01	2160	24	24.73	24.08	.0115	24.76	.0006	287	747
			12	16.38	16.10	.0075	16.86	.0125		
		1080	24	35.77	35.10	.0082	35.05	.0089		
		360	24	58.90	58.80	.0007	56.85	.0154		
	1.33	2160	12	12.56	12.75	.0065	13.28	.0242	270	919
		1080	24	28.08	28.21	.0020	28.84	.0116		
		360	24	48.53	49.52	.0088	48.66	.0015		
	1.	600	12	22.28	21.98	.0055	22.83	.0106	259	1063
			4	12.22	11.76	.0167	11.92	.0108		
DUBUAT		737	23.7	28.67	29.41	.0111	30.11	.0213		
			12.2	19.99	19.95	.0009	20.67	.0145		
			4.2	10.56	10.66	.0041	10.90	.0137		
		117	36	84.95	85.52	.0029	83.12	.0069		
			18	58.31	58.47	.0014	58.41	.0012		
	.24167	36.25	53.25	85.77	85.20	.0029	85.71	.0003	309	2268
			41.25	73.81	73.90	.0005	74.67	.0050		
			20.17	51.96	50.14	.0155	50.87	.0093		
			5.00	23.40	23.19	.0039	23.09	.0058		
			.83	7.58	8.22	.0420	7.22	.0212		
	.1667	36.25	51.25	64.37	64.95	.0031	64.08	.0021	402	2827
			38.75	54.19	55.32	.0090	54.93	.0055		
			15.29	33.38	33.17	.0028	32.67	.0094		
			2.04	10.62	10.49	.0058	9.24	.0604		
	.125	34.17	42.17	45.47	46.21	.0070	45.88	.0039	518	3405
			35.33	41.61	41.71	.0010	41.55	.0006		
			14.58	26.20	25.52	.0114	24.94	.0214		
			2.08	7.32	8.35	.0572	6.98	.0206		
						(Mean .0178 = L.1.042)		(Mean .0169 = L. 1.040)		

Observers.	*d.*	*l.*	*k.*	*v.*	Dub.	Log. rat.	Y	Log. rat.	*a*	− *c*
GERSTNER at 55.5°F.	.2	63	10.7	24.2	23.9	.006	24.1	.002	349	2533
			7.7	21.0	19.9	.023	19.1	.042		
			4.7	15.8	14.9	.026	13.9	.056		
			1.7	7.5	8.2	.039	6.9	.036		
			.7	2.5	5.0	.301	3.4	.133		
	.133	33	10.7	27.1	23.4	.064	22.5	.081	486	3259
			7.7	23.2	19.4	.077	18.5	.098		
			4.7	15.4	14.6	.024	13.5	.058		
			1.7	5.6	8.1	.160	6.7	.078		
			.7	2.3	4.6	.301	3.4	.169		
	.0674	33	10.7	10.0	8.9	.051	10.1	.004	975	5700
			7.7	7.2	7.4	.012	8.2	.057		
			4.7	4.5	5.6	.095	5.6	.095		
			1.7	1.5	3.1	.316	2.5	.222		
			.7	.5	1.8	.444	1.1	.342		
					(Mean	.129=L.1.346		.098=L.1.254)		
Y. At 60°	$\frac{1}{42}$	8.50	32.4	14.40	0	∞	13.36	.032	2956	13882
	$\frac{1}{133}$	3.42	30.0	.53			.52	.008	13404	452100
		1.17	5.8	.27			.30	.046		
							(Mean	.029=L.1.068)		
DUBUAT	2	255.25	36.35	86.31	84.2	.011	79.7	.035	287	747
	1	24	36.25	122.59	117.8	.018	120.8	.007	259	1063
			27	106.45	101.1	.022	104.1	.010		
			18	84.85	82.2	.013	84.8	.000		
			9	59.25	57.5	.013	59.7	.004		
		4	27.08	118.67	111.5	.027	118.5	.000		
					Mean	.017=L.1.041		.009=L.1.022)		

It appears from this comparison, that in the forty experiments extracted from the collection, which served as a basis for Dubuat's calculations, the mean error of his formula is $\frac{1}{24}$ of the whole velocity, and that of mine $\frac{1}{25}$ only; but, if we omit the four experiments, in which the superficial velocity only of a river was observed, and in which I have calculated the mean velocity by Dubuat's rules, the mean error of the remaining 36 is $\frac{1}{35}$, according to my mode of calculation, and $\frac{1}{37}$ according to Mr. Dubuat's; so that, on the whole, the accuracy of the two formulæ may be considered as precisely equal with respect to these experiments. In the six experiments which Dubuat has wholly rejected, the mean error of his formula is about $\frac{1}{11}$, and that of mine $\frac{1}{12}$. In fifteen of Gerstner's experiments the mean error of Dubuat's rule is one-third, that of mine one-fourth; and in the three experiments which I made with very fine tubes, the error of my own rules is one-fifteenth of the whole, while in such cases Dubuat's formulæ completely fail. I have determined the mean error by adding together the logarithmic ratios of all the results, and dividing the sum by the number of experiments. It would be useless to seek for a much greater degree of accuracy, unless it were probable that the errors of the experiments themselves were less than those of the calculations; but if a sufficient number of extremely accurate and frequently repeated experiments could be obtained, it would be very possible to adapt my formula still more correctly to their results.

In order to facilitate the computation, I have made a table of the coefficients *a* and *c* for the different values of *d*, all the measures being still expressed in French inches.

Table of Coefficients for French Inches.

d	*a* $.1^7\times$	*c* $.1^7\times$	*d*	*a* $.1^7\times$	*c* $.1^7\times$	*d*	*a* $.1^7\times$	*c* $.1^7\times$	*d*	*a* $.1^7\times$	*c* $.1^7\times$
∞	430	900	40	400	719	4	319	540	.4	257	1717
500	427	943	30	393	618	3	305	617	$\frac{1}{3}$	268	1895
400	426	946	25	387	560	2.5	296	687	.3	279	2008
300	423	950	20	380	492	2	288	751	$\frac{1}{4}$	303	2225
200	421	937	15	370	427	1.5	275	866	.2	349	2532
100	416	923	10	354	414	1	259	1063	$\frac{1}{6}$	402	2827
90	415	911	9	350	421	.9	255	1123	.15	440	3026
80	413	896	8	345	433	.8	252	1193	$\frac{1}{7}$	458	3116
70	410	872	7	340	440	.7	249	1278	$\frac{1}{8}$	518	3405
60	408	840	6	335	462	.6	248	1384	$\frac{1}{9}$	589	3693
50	406	792	5	325	512	.5	249	1524	.1	646	3985

For example, in the last experiment, where d is 1,14, and h 27.1, we have $a = .0000259$, $b = \frac{1}{al:d + .00182} = 516$, $c = .0001063$, $e = bcl:d = .22$, and $v = \sqrt{(bh + e^2)} - e = 118.46$, which agrees with the experiment within $\frac{1}{100}$ of the whole. I had at first employed for a the formula $\frac{430}{1 + 88cd} + \frac{57}{d} + \frac{1}{5dd}$, but I found that the value, thus determined, became too great when d was about 20, and two small in some other cases. Coulomb's experiments on the friction of fluids, made by means of the torsion of wires, give about .00014 for the value of c, which agrees as nearly with this table as any constant number could be expected to do. I have however reason to think, from some experiments communicated to me by Mr. Robertson Buchanan, that the value of a, for pipes about half an inch in diameter, is somewhat too small; my mode of calculation, as well as Dubuat's, giving too great a velocity in such cases.

If any person should be desirous of making use of Dubuat's formula, it would still be a great convenience to begin by determining v according to this method; then, taking $b = \frac{l}{h - v^2 : 478}$, or rather, as Langsdorf makes it, $b = \frac{l}{h - v^2 : 482}$, to proceed in calculating v by the formula $v = 148.5\,(\sqrt{d} - .2) \cdot \left(\frac{1}{\sqrt{b} - \text{H.L.}\sqrt{(b + 1.6)}} - .001\right)$, since this determination of b will, in general, be far more accurate than the simple expression $b = \frac{l + 45d}{h}$, and the continued repetition of the calculation, with approximate values of v, may thus be avoided. Sometimes, indeed, the values of v found by this repetition will constitute a diverging instead of a converging series, and in such cases we can only employ a conjec-

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tual value of v, intermediate between the two preceding ones.

Having sufficiently examined the accuracy of my formula, I shall now reduce it into English inches, and shall add a second table of the coefficients, for assisting the calculation. In this case a becomes $.0000001\left(413+\frac{75}{d}-\frac{1440}{d+12.8}-\frac{180}{d+.355}\right)$, $c=.0000001\left(\frac{900dd}{dd+1136}+\frac{1}{\surd d}\right.$ $\left.\left(1085+\frac{13.21}{d}+\frac{1.0563}{dd}\right)\right)$, and $b=\frac{1}{al:d+.00171}$, e being $\frac{bc}{d}$, and $v=\surd(bh+e^2)-e$; or $=\surd\left(\frac{ds}{a}+\frac{ce}{aa}\right)-\frac{e}{a}$, as before; and in either case the superficial velocity of a river may be found, very nearly, by adding to the mean velocity v its square root, and the velocity at the bottom by subtracting it.

Table of Coefficients, for English Inches.

d.	a. $.1^7\times$	c. $.1^7\times$	d.	a. $.1^7\times$	c. $.1^7\times$	d.	a. $.1^7\times$	c. $.1^7\times$	d.	a. $.1^7\times$	c. $.1^7\times$
∞	413	900	40	383	698	4	306	556	.4	254	1779
500	410	944	30	377	597	3	292	635	$\frac{1}{3}$	268	1963
400	409	948	25	371	526	2.5	284	694	.3	280	2082
300	406	951	20	364	482	2	277	774	$\frac{1}{4}$	305	2307
200	404	951	15	354	430	1.5	266	894	.2	354	2631
100	399	918	10	339	413	1	251	1099	$\frac{1}{6}$	409	2943
90	398	903	9	336	421	.9	248	1161	.15	447	3150
80	396	885	8	331	433	.8	245	1234	$\frac{1}{7}$	466	3251
70	393	860	7	327	449	.7	243	1322	$\frac{1}{8}$	528	3558
60	391	825	6	322	471	.6	243	1433	$\frac{1}{9}$	599	3866
50	389	772	5	312	507	.5	245	1578	.1	657	4183

II. *Of the Resistance occasioned by Flexure in Pipes or Rivers.*

Mr. Dubuat has made some experiments on the effect of the flexure of a pipe in retarding the motion of the water flowing through it; but they do not appear to be by any means sufficient to authorise the conclusions which he has drawn from them. He directs the squares of the sines of the angles of flexure to be collected into one sum, which, being multiplied by a certain constant coefficient and by the square of the velocity, is to shew the height required for overcoming the resistance. It is, however, easy to see that such a rule must be fundamentally erroneous, and its coincidence with some experiments merely accidental, since the results afforded by it must vary according to the method of stating the problem, which is entirely arbitrary. Thus it depended only on Mr. Dubuat to consider a pipe bent to an angle of 144° as consisting of a single flexure, as composed of two flexures of 72° each, or of a much greater number of smaller flexures, although the result of the experiment would only agree with the arbitrary division into two parts, which he has adopted. This difficulty is attached to every mode of computing the effect either from the squares of the sines or from the sines themselves; and the only way of avoiding it is to attend merely to the angle of flexure as expressed in degrees. It is natural to suppose that the effect of the curvature must increase as the curvature itself increases, and that the retardation must be inversely proportional to the radius of curvature, or very nearly so; and this supposition is sufficiently confirmed by the experiments which Mr. Dubuat has employed in support of a theory so different. It might be expected that an equal curvature would create a greater resistance in a larger pipe than in a smaller, since the inequality in the motions of the different parts of the fluid is greater; but this circumstance does not seem to have influenced the results of the experiments made with pipes of an inch and of two inches diameter: there must also be some deviation from the general law, in cases of very small pipes having

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ing a great curvature, but this deviation cannot be determined without farther experiments. Of the 25 which Dubuat has made, he has rejected 10 as irregular, because they do not agree with his theory: indeed 4 of them, which were made with a much shorter pipe than the rest, differ so manifestly from them that they cannot be reconciled: but 5 others agree sufficiently, as well as all the rest, with the theory which I have here proposed, supposing the resistance to be as the angular flexure, and to increase besides almost in the same proportion as the radius of curvature diminishes, but more nearly as that power of the radius of which the index is seven-eighths. Thus if p be the number of degrees subtended at the center of flexure, and q the radius of curvature of the axis of the pipe in French inches, we shall have $r = \frac{pv^2}{2000000q}$ nearly, or, more accurately, $r = \frac{.0000045pv^2q^{\frac{1}{8}}}{q}$. These calculations are compared with the whole of Dubuat's experiments in the following table.

Table of Experiments on the Resistance occasioned by Flexure.

p	q	v^2	r	B.	Y.1	Y.2	p	q	v^2	r	B.	Y.1	Y.2
288	3.22	15030	4.75		6.71	6.98	288	3.22	3415	1.50	1.57	1.52	1.58
		11330	3.50		5.06	5.26	144			.75	.78	.76	.79
		7199	2.33		3.21	3.34	72			.37	.39	.38	.39
		3510	1.08		1.56	1.62	196.5	6.12		.75	.78	.55	.62
216		7216	2.49	2.49	2.42	2.52	112.5	.53		1.50		3.63	3.00
144			1.50	1.66	1.61	1.67	720	3.22	5125	5.90	5.90	5.72	5.95
72			.75	.83	.80	.83	288		3458	1.64	1.59	1.54	1.60
196.5	6.12		1.50	1.66	1.16	1.31			860	.41	.40	.38	.40
147.4			1.12	1.24	.87	.98	—		821	.39	.38	.37	.38
98.3			.75	.83	.58	.65	288	4.10	3448	1.33		1.21	1.30
49.1			.37	.41	.29	.33			7449	2.90		2.59	2.78
112.5	.53		6.00		7.68	6.36	294.8	9.9		8.64		8.09	8.62
99			5.90		6.74	5.60	360	4.1					
288	3.22	3415	1.50	1.57	1.52	1.58	112.5	1.1					

In the last three experiments, the diameter of the pipe was two inches. The radius of curvature is not ascertained within the tenth of an inch, as Dubuat has not mentioned the thickness of the pipes. The mean error of his formula in fifteen experiments, and of mine in twenty, is $\frac{1}{25}$ of the whole.

TO BE CONCLUDED IN OUR NEXT.

Electro-Chemical Researches, on the Decomposition of the Earths; with Observations on the Metals obtained from the alkaline Earths, and on the Amalgam procured from Ammonia.

By HUMPHRY DAVY, *Esq. Sec. R. S. M. R. I. A.*

From the PHILOSOPHICAL TRANSACTIONS of the ROYAL SOCIETY of LONDON.

I. *Introduction.*

IN the Philosophical Transactions for 1807, Part I. and 1808, Part I. I have detailed the general methods of decomposition by electricity, and stated various new facts obtained in consequence of the application of them.

The results of the experiments on potash and soda, as I stated in my last communication to the Society, afforded me the strongest hopes of being able to effect the decomposition both of the alkaline and common earths; and the phenomena obtained in the first imperfect trials made upon those bodies countenanced the ideas that had obtained from the earliest periods of chemistry, of their being metallic in the nature *.

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* Beccher is the first chemist, as far as my reading informs me, who distinctly pointed out the relations of metals to earthy substances,

Many difficulties however occurred in the way of obtaining complete evidences on this subject: and the pursuit of the enquiry has required much labour and a considerable devotion of time, and has demanded more refined and complicated processes than those which had succeeded with the fixed alkalies.

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stances, see Phys. subt. Lipsiæ, 4to. p. 61. He was followed by Stahl, who has given the doctrine a more perfect form. Becher's idea was that of an universal elementary earth, which, by uniting to an inflammable earth, produced all the metals, and under other modifications formed stones. Stahl admitted distinct earths which he supposed might be converted into metals by combining with phlogiston; see Stahl, Fundament. Chym. p. 9. 4to. and Conspect. Chem. I. 77. 4to.—Neuman gives an account of an elaborate series of unsuccessful experiments which he made to obtain a metal from quicklime. Lewi's Neuman's Chem. Works, 2d. edit. vol. i. p. 15. The earlier English chemical philosophers seem to have adopted the opinion of the possibility of the production of metals from common earthy substances; see Boyle, vol. i. 4to. p. 564. and Grew, Anatomy of Plants, lec. ii. p. 242. But these notions were founded upon a kind of alchemical hypothesis of a general power in nature of transmuting one species of matter into another. Towards the end of the last century the doctrine was advanced in a more philosophical form: Bergman suspected barytes to be a metallic calx, Præf. Sciagrap. Reg. Min. & Opusc. iv, 212. Baron supported the idea of the probability of alumine being a metallic substance, see Annales de Chemie, vol. x, p. 257.—Lavoisier extended these notions, by supposing the other earths metallic oxyds. Elements, 2d edit. Kerr's translation, p. 217. The general enquiry was closed by the assertion of Tondi and Ruprecht, that the earths might be reduced by charcoal; and the accurate researches of Klaproth and Savaresi, who proved by the most decisive experiments, that the metals taken for the bases of the earths were phosphurets of iron, obtained from the bone ashes and other materials employed in the experiment, Annales de Chimie, vol. viii. p. 18, and vol. x. p. 257, 275. Amidst all these hypotheses, potash and soda were never considered as metallic in their nature; Lavoisier supposed them to contain azote; nor at that time were there any analogies to lead that acute philosopher to a happier conjecture.

The earths, like the fixed alkalies, are non-conductors of electricity; but the fixed alkalies become conducting by fusion: the infusible nature of the earths, however, rendered it impossible to operate upon them in this state: the strong affinity of their bases for oxygene, made it unavailing to act upon them in solution in water; and the only methods that proved successful, were those of operating upon them by electricity in some of their combinations, or of combining them at the moment of their decomposition by electricity, in metallic alloys, so as to obtain evidences of their nature and properties.

I delayed for some time laying an account of many of the principal results which I obtained before the Society, in the hopes of being able to render them more distinct and satisfactory; but finding that for this end a more powerful battery, and more perfect apparatus than I have a prospect of seeing very soon constructed, will be required, I have ventured to bring forward the investigation in its present imperfect state; and I shall prefer the imputation of having published unfinished labours, to that of having concealed any new facts from the scientific world, which may tend to assist the progress of chemical knowledge.

2. *Methods employed for decomposing the alkaline Earths.*

Barytes, strontites, and lime, slightly moistened, were electrified by iron wires under naphtha, by the same methods, and with the same powers as those employed for the decomposition* of the fixed alkalies. In these cases, gas was copiously evolved, which was inflammable; and the earths, where in contact with the negative metallic wires, became dark-coloured, and exhibited small points having a metallic lustre, which, when exposed to air, gradually became white; they became white likewise when plunged under water, and when examined in this experiment by a magnifier, a greenish powder seemed to separate from them, and small globules of gas were disengaged.

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* See page 4, Phil. Trans. 1808, Part I.

In these cases there was great reason to believe that the earths had been decomposed; and that their bases had combined with the iron, so as to form alloys decomposible by the oxygen of air or water; but the indistinctness of the effect, and the complicated circumstances required for it, were such as to compel me to form other plans of operation.

The strong attraction of potassium for oxygen, induced me to try whether this body might not detach the oxygen from the earths, in the same manner as charcoal decomposes the common metallic oxyds.

I heated potassium in contact with dry pure lime, barytes, strontites, and magnesia, in tubes of plate glass; but as I was obliged to use very small quantities, and as I could not raise the heat to ignition without fusing the glass, I obtained in this way no good results. The potassium appeared to act upon the earths and on the glass, and dark brown substances were obtained, which evolved gas from water; but no distinct metallic globules could be procured: from these circumstances, and other like circumstances, it seemed probable, that though potassium may partially de-oxygenate the earths, yet its affinity for oxygen, at least at the temperature which I employed, is not sufficient to effect their decomposition.

I made mixtures of dry potash in excess and dry barytes, lime, strontites, and magnesia, brought them into fusion, and acted upon them in the Voltaic circuit in the same manner as that I employed for obtaining the metals of the alkalies. My hopes were, that the potassium, and the metals of the earths might be de-oxygenated at the same time, and enter into combination in alloy.

In this way of operating, the results were more distinct than in the last: metallic substances appeared, less fusible than potassium, which burnt the instant after they had formed, and which by burning produced a mixture of potash and the earth employed; I endeavoured to form them under naphtha, but without much success. To produce the result at all, required a charge by the action of nitric acid, which the state of the batteries did not permit me often to employ *; and the metal was generated only in very minute films, which could not be detached by fusion, and which were instantly destroyed by exposure to air.

I had found in my researches upon potassium, that when a mixture of potash and the oxyd of mercury,

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* The power of this combination, though it consisted of one hundred plates of copper and zinc of six inches, and one hundred and fifty of four inches, at this time was not more than equal to that of a newly-constructed apparatus of one hundred and fifty, of four inches. It had been made for the demonstrations in the Theatre of the Royal Institution in 1803; and since that time had been constantly employed in the annual courses of Lectures, and had served in different parts, for the numerous experiments on the decomposition of bodies by electricity, detailed in the Bakerian Lectures for 1806 and 1807, and a number of the plates were destroyed by corrosion. I mention these circumstances, because many chemists have been deterred from pursuing experiments on the decomposition of the alkalies and the earths, under the idea that a very powerful combination was required for the effect. This, however, is far from being the case; all the experiments detailed in the text may be repeated by means of a Voltaic battery, containing from one hundred to one hundred and fifty plates of four or six inches.

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tin, or lead, was electrified in the Voltaic circuit, the decomposition was very rapid, and an amalgam, or an alloy of potassium was obtained; the attraction between the common metals and the potassium apparently accelerating the separation of the oxygen.

The idea that a similar kind of action might assist the decomposition of the alkaline earths, induced me to electrify mixtures of these bodies and the oxyd of tin, of iron, of lead, of silver, and of mercury; and these operations were far more satisfactory than any of the others.

A mixture of two-thirds of barytes and one-third of oxyd of silver very slightly moistened was electrified by iron wires; an effervescence took place at both points of contact, and a minute quantity of a substance, possessing the whiteness of silver, formed at the negative point. When the iron wire to which this substance adhered was plunged into water containing a little alum in solution, gas was disengaged, which proved to be hydrogen; and white clouds which were found to be sulphate of barytes, descended from the point of the wire.

A mixture of barytes and red oxyd of mercury, in the same proportions, was electrified in the same manner. A small mass of solid amalgam adhered to the negative wire, which evidently contained a substance, that produced barytes by exposure to air, with the absorption of oxygen; and which occasioned the evolution of hydrogen from water, leaving pure mercury, and producing a solution of barytes.

Mixtures of lime, strontites, magnesia, and red oxyd of mercury, treated in the same manner, gave similar amalgams, from which the alkaline earths were regenerated by the action of air or water, with like phenomena;

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but the quantities of metallic substances obtained were exceedingly minute; they appeared as mere superficial formations surrounding the point of the wire, nor did they increase after the first few minutes of electrization, even when the process was carried on for some hours.

These experiments were made previous to April, 1808, at which time the batteries were so much injured by constant use, as no longer to form an efficient combination. The enquiry was suspended for a short time: but in May I was enabled to resume it, by employing a new and much more powerful combination, constructed in the Laboratory of the Royal Institution, and consisting of five hundred pairs of double plates of six inches square.

When I attempted to obtain amalgams with this apparatus, the transmitting wires being of platina, of about $\frac{1}{10}$ of an inch in diameter; the heat generated was so great as to burn both the mercury and basis of the amalgam at the moment of its formation; and when by extending the surfaces of the conductors, this power of ignition was modified, yet still the amalgam was only produced in thin films, and I could not obtain globules sufficiently large to submit to distillation. When the transmitting wires were of iron of the same thickness, the iron acquired the temperature of ignition, and combined with the bases of the earths in preference to the mercury, and metallic alloys of a dark grey colour were obtained, which acted on water with the evolution of hydrogen, and were converted into oxyd of iron, and alkaline earths.

TO BE CONTINUED IN OUR NEXT.

On

On the Blight in Wheat.

By Mr. THOMAS DAVIS *of Horningsham.*

From the LETTERS and PAPERS of the BATH and WEST of ENGLAND SOCIETY.

THE opinion I gave in the Bath Society's Papers, vol. X. p. 41, that the wheat blight is a *plant*, and not an insect, is now fully confirmed by the microscopical observations of that able naturalist Sir Joseph Banks, who, in his treatise on the subject, has given magnified representations of the plant, in which its form and fructification are so conspicuous, that no one can doubt the fact.

Sir Joseph also describes the manner in which the minute seeds of this plant (which are as light as air) are carried by the wind, and lodged on the growing stalks of wheat, where they take root, and vegetate, and like all other parasitical plants, rob the plant to which they attach of its nourishment, to support themselves. The effect is too well known. The rapidity with which these minute plants vegetate, and the destruction they make in a crop of wheat, of which the ears only a few days before appeared full and heavy and nearly fit for the sickle, can scarcely be believed by those who have not observed it, and is astonishing even to those who have watched its progress. It seems to produce something more than a mere cessation of growth. *Its action is like that of poison.* It absorbs the *farina* or flour of the fairest and plumpest grain, and reduces it to a mere shell of bran.

But although the nature of this disease is now so well known, the remedy is not so easily found. With all due deference to the great abilities of Sir Joseph Banks, I am not so sanguine as to expect that it can be eradicated by pulling up the diseased plants; or even, if it were practicable, by burning all the straw of every blighted crop.

The seeds of this destructive plant are too minute and abundant, and capable of being wafted to too great a distance, to be totally destroyed. A single acre of blighted wheat will produce seed enough to supply a whole district; and indeed it is now well known to botanists, that the plant grows and flourishes on many *other plants* besides wheat. And were there but a single piece of wheat in a country where none had grown before, the enemy would be ready for the attack, whenever there was a *predisposing* cause in the wheat crop to receive it.

It is probably not within the power of man to prevent, *totally*, the ravages of this destructive, though minute enemy to agriculture, but it may yet be in his power to reduce them in a considerable degree, by ascertaining and obviating the *causes which peculiarly dispose and prepare the wheat plant* for its attacks. These may be summed up in one word, viz. *weakness*, or *debility*.

The class of plants called by botanists mosses and lichens, are the *insects of the vegetable kingdom, created to prey on weak plants, as the insects of the animal kingdom are to prey on weak animals.* In both instances, the juices by being weakened and deprived of their acridity, become *their* proper food. The *remedy* must be to restore to the object *its natural health and vigour.*

To apply this argument to wheat, and to shew the causes which render it unproductive, it will be necessary to consider the nature of the plant, and the kind of cultivation which usually renders it productive.

It is well known, that nature has furnished the wheat plant with a double set of roots, so contrived that the first may be deep enough to enable it to stand the severity of the winter; and the second so shallow as to admit the genial influence of the spring. It first shoots down a perpendicular *tap-root*, which supports the plant and keeps it *steady* during the winter; and in the spring it tillers out a number of *coronal shoots*, *each* of which has its *own proper root*, and produces its *own ear*, though still adhering to and dependent on each other for mutual support; and when that operation is complete, the winter root *becomes useless* and *dies.*

If this winter root be imperfect, the side shoots which are to produce the crop will also be so. A strong solid *foothold* for the tap-root is therefore necessary for wheat; and the more complete the winter root is, before the spring tillering takes place, the more perfect will be the crop. If the formation of the young plants be unequal, so will be the ripening of the crop; and if the ripe ears on one part of the plant are waiting for the green ones on the other, the blight generally attacks the crops.

A *thin* crop of wheat, and a *late ripening* crop, (and a thin crop is usually a late ripening one,) are the peculiar *prey of the blight*; and these are generally produced either by sowing land with wheat, which is unfit for wheat, or in an improper state of cultivation, or by sowing it in an improper season. *In fine, any cause which tends to weaken the plant, will predispose it to receive the blight.*

The causes which tend to weaken the wheat plant, are many, but the following are the most obvious:

1st. Sowing wheat on land that has been so worn out by cropping, as to have lost that *tenacity* and *cohesion* which are so necessary to a wheat crop, and which even dung, *without rest*, will not restore.

2dly. Sowing the land in a light loose state, whereby the wheat plant roots too near the surface, and is liable to be injured by the winter's frost, and to have its roots laid bare by the wind.

3dly. Sowing wheat too late in the autumn, (which is too common,) especially in poor land and exposed situations, where the roots have not time to establish themselves before the winter comes on, and vegetation is totally at a stand.

Now as these causes have, in consequence of the advance in the price of wheat, occurred more frequently of late years than formerly; it is probable that the assertion "that the blight on wheat has increased of late years," may be true. For,

1st. It has not been uncommon to sow land with wheat every *third* year, instead of every fourth or fifth; and as the land, in the interim, has been under crops, the very nature of which is to make land light, and no fallow year having been allowed to get it close again; the crops, though abundant in straw, have not had strength enough to support them till harvest, and have been *laid by the rains*, and thereby become a prey to the blight.

2d. It has been very much the practice of late years to sow wheat after *turnips*, and very *clean* crops have been produced thereby. But this system is wrong: the turnips are eaten before they are wanted, and the wheat is sown a month too late; and being necessarily *late ripe*, is often attacked by the blight.

3d. It has been also a frequent practice to sow wheat *after potatoes*; and this system is still worse: the land is rendered too light for wheat, and the seed time is much too late, unless it be in deep rich land, where the wheat plants will grow during the whole of the winter.

4th. And even the practice of sowing *wheat after clover* has been carried to too great an extent on light land, especially where the land is nearly tired of clover. It encourages the *slug*, and the *wireworm*, which destroy a considerable part of the wheat plants, leaving the residue a *thin unequal crop*, which the blight seldom fails to attack, and frequently to ruin.

To sum up the whole:—If it can be proved, (and every man *who is a farmer* must have observed it,) that all *weak crops* of wheat, and particularly all *late-ripe crops*, are peculiarly subject to blight; it should be the great object of every farmer to sow such land, *and such only*, to wheat, as is fit for wheat; to get it in order *early* in the summer, that it may be *close* and *firm* before sowing; to sow as *early* as the state of the weather will permit, particularly in cold soils or exposed situations; and to sow *those kinds of wheat* which are disposed to *ripen* early, (a circumstance much more attended to in Scotland than in England;) but above all, not to wear out his land by cropping it *oftener with wheat* than its nature will bear; always considering that it is *not the number of acres sown*, but *the number of bushels produced*, that will *enrich the farmer*, or *supply the market*.

When I assert that *weak* crops are the most susceptible of blight, I do not altogether mean such crops as are weak *in consequence of a want of manure*, but such as grow on land which has been made so light by repeated culture, that the plants cannot get firm *foothold*, the great *desideratum*, in fact the *sine quâ non*, of a good wheat crop; and manure, particularly horse-dung, instead of remedying this defect, only adds to the evil. In that instance, the remark which has been often made, that the highest manured crops are the most susceptible of blight, is perfectly consonant with my observation. For the same reason, these crops are apt to fall before they are ripe, and in that situation, if there be any blight in the air, they are sure to be infected with it, because the sun cannot dry them, and the circulation of the sap is impeded by the bruising of the straw.

It was well observed in one of the Agricultural Reports, "that land may be made so drunk with dung, that a wheat crop cannot stand upon it:" and I will defy any man to get a good *yielding* crop of wheat in a highly-manured garden. He may, and probably will, get a good crop of *straw*.

Mr. A. Young is right, in saying in his Annals, that on *high* land, *not of the best quality*, wheat is seldom blighted. The reason is, that such land is not made too loose by culture and manure, and the straw stands upright and exposed to the sun and wind. I had a very striking instance of this on the Marquis of Bath's land, under my care, a few years ago; I had ploughed up 20 acres of furze-land in the autumn, with intent to sow it to wheat. It was run back in the spring, and cross-ploughed early in the summer, so as to be quite close and firm before wheat sowing; but having occasion to plant two acres of potatoes, I took part of this land and manured it well with rotten dung, and planted the potatoes therein. They were ripe early, and when dug the two acres were sown with wheat; on the same day, the rest of the piece, which had not been dunged at all, was sown. The wheat on the two acres was much the proudest during the winter, and the best crop when it came into ear; but when it was just ripe, (which was ten days after the other part,) the blight struck it, and it was as black as a coal, while the rest was as bright as silver. In fact the two acres were scarcely worth reaping.

Again, with respect to *late-ripening* crops being subject to the blight, I am of opinion that the act of ripening wheat and all annual graminiferous plants, is not so much an effort of nature as a *cessation of nature's efforts;* and that no crop of grain can be a good one, unless the whole ripens together; and if by any cause, particularly by the seed being sown too thin, or by a partial failure of the plants from a severe winter, the plant is forming new roots, or one part of it is doing so, while the other is or ought to be ripening its seed, the straw keeps green and moist, instead of turning yellow and dry, and the blight is sure to take it. And this has brought drilling into disgrace more than all other causes, particularly when the crop has been sown too thin, or the hoe has been used too late *.

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* I have just been a witness to the threshing a piece of drilled wheat which was injured by harrowing in grass seeds in April: the harrowing made the wheat too thin, and caused it to throw out new shoots; it kept growing while it ought to have been ripening; it of course took the blight, and though the ears were six inches long, the produce weighed only 40lb. per bushel.

Account of Swedish Turnips, produced in a Field at Toft, in Cheshire, in 1806. *Transmitted to the Board of Agriculture, by* JOHN *Lord* SHEFFIELD.

From the COMMUNICATIONS to the BOARD OF AGRICULTURE.

Extract of a Letter from Lord SHEFFIELD, *to* ARTHUR YOUNG, *Esquire, Secretary to the Board of Agriculture; dated Sheffield Place,* 28*th Feb.* 1808.

THE best Swedish turnips I have seen this year, were at Mr. Leycester's, near Knutsford, in Cheshire. The first of the following papers contains the account that was given me of a crop grown by him in the year 1806. The second contains the answers to some queries I had made. I am not sure that they contain any thing that will be new to the Board; but I was pleased with the crop, and with learning that the Swedish turnips had repeatedly succeeded under the same management.

Communications from Mr. Leycester.

Produce.

785 lbs. per rood of 64 yards, or 3 loads and 5 lbs. of 13 score per load=52 tons 6 cwt. 2 qrs. 2lbs. per Cheshire acre (nearly double the statute).

Tops.

75 lbs. per rood=to 46 loads, or 5 tons per acre, Cheshire.

Turnips and Tops.

57 tons, 6 cwt. 2 qrs. 20 lbs. per acre, Cheshire.

Loads of Turnips and Tops.

483 loads	at 4*s.* =£.96 12	}	£.101. 4*s.* per acre.
46 loads tops,	at 2*s.* =£. 4 12	}	

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The above average crop was taken by weighing six separate roods in different parts of the field, not particularly selected as being the best, but avoiding such spots as had been destroyed by the drought and by the wireworm; and one part that was shaded by a row of elms. They are now selling at 4*s.* per load, Jan. 12, 1807.

The soil a light loam inclined to sand. The crop of turnips described above, was taken after two white crops. After the second was got off, the land was fallowed as thin as possible, harrowed as often as weed made its appearance, and in this state lay all winter. In spring, about a month before the time of transplanting, it was ploughed again about 8 inches deep, harrowed, and then drawn into ridges 27 inches asunder, manured with a strong compost, which was covered, by throwing two furrows upon it. The top of the ridge was then raked off, and the plants set upon it.

The seed sown the middle of April, or end of March; transplanted the 1st and 2d weeks in June.

The rows, as before stated, were 27 inches apart; the plants set at 17 inches asunder in the row.

We have usually planted Swedish turnips upon land which had been oats the preceding year. Sow the seed (when possible upon some corner of the same field where they were to be planted) the middle or latter end of April. If the weather has been favourable for them, they have been ready to transplant early in June, and we have even planted as late as the middle of July, which have turned out to good account.

The land has been drawn into ridges, two feet asunder (I recommend 27 inches), and manured with a compost, two furrows thrown upon it, and upon them the plants set at about 17 or 18 inches apart in the row.

When weed comes we have ploughed from them, and when the plants were out of danger of being buried, up to them again. These ploughings have been repeated as long as we could come among them without injuring the plants.

We have generally made a point of getting a quantity up, before severe frost has set in, in order to have a constant supply, laying them in a long heap (out of doors) 2 yards broad at the bottom, bringing them to a point at the top, so that the depth has been about a yard, covering the whole with thatch. In this way they will keep good till far on in spring. The bulk of them have remained in the ground till they have been wanted, and we have had them quite sound till the end of April; produce from 50 to 60 tons per acre *.

It is my opinion, that stall feeding during the whole of the year, would not be a profitable practice for the dairy farmer; but on this head, I do not speak from experience.

The crop of beans we have this year, was taken after oats. The ground was fallowed immediately after the oats were got off, harrowed, and brought into condition to be drawn into ridges before winter. The ridges were 2 feet asunder (I should however recommend 27 inches, as 2 feet is barely sufficient for a horse to pass through, for the purpose of clearing them). In this state the ground lay till the beginning of March, when the beans were set between the ridges at 3 inches asunder. Ten women having the length of the field equally divided among them, dropped them as fast as a man with one horse and plough could cover them, by throwing two

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* A Cheshire Acre, which is nearly double the statute.

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furrows upon them. In this way they set a Cheshire acre per day.

The clearing was performed as for the Swedish turnips. In both cases, however, it has been necessary to go over them with the hoe, when the plough could no longer come among them.

We purpose taking wheat after them; and I conceive the ground is almost in as good condition, as if it had been a summer fallow.

Not having had much experience as to the culture of beans, I cannot give a positive answer whether they are, or are not, an exhausting crop. I am much inclined to think they are not, and flatter myself we shall have as good a crop of wheat as after a summer fallow.

Produce of mazegan beans 133 bushels per acre; of the horse beans 96 ditto.

These were thrashed soon after they were housed, and although pretty dry, would no doubt shrink.

List of Patents for Inventions, &c.

(Continued from Vol. XIII. Page 416.)

Edward Thomason, of Birmingham, in the county of Warwick, Manufacturer; for various improvements in the construction of umbrellas and parasols. Dated October 8, 1808. Specification to be enrolled within one month.

Richard Trevithick, of Rotherhithe, in the county of Surrey, Engineer, and **Robert Dickinson**, of Great Queen-street, in the county of Middlesex, Esquire; for a new method or way of stowing cargoes of ships and other vessels by means of packages, for containing goods and products of certain descriptions destined for conveyances by sea not hitherto employed, by which means expenses of stowage-room will be saved, and the contents be rendered more secure from damage. Dated October 31, 1808. Specification to be enrolled within six months.

HENRY VAN WART, of Liverpool, in the county palatine of Lancaster, Merchant; for a method of making a machine for manufacturing thimbles for the sails of ships and vessels, and for all sorts of rigging, and other purposes. Communicated to him by **ISAIAH JENNINGS**, a citizen of the United States of America. Dated October 31, 1808. Specification to be enrolled within one month.

JOSEPH ANTHONY BERROLLAS, of Denmark-street, in the parish of Saint Giles in the Fields, in the county of Middlesex, Watch-maker; for a method of making infallible repeating watches. Dated October 31, 1808. Specification to be enrolled within one month.

ZACHARIAH BARRATT, of Croydon, in the county of Surrey, Gentleman; for a machine for washing linen and cotton clothes, and other similar things; to which may be affixed or omitted at pleasure a contrivance for pressing the water from them, now commonly done by wringing. Dated October 31, 1808. Specification to be enrolled within one month.

PHINEAS ANDREWS, of Haverstock-hill, in the parish of Hampstead, in the county of Middlesex, Gentleman; for certain improvements in the construction of a machine for threshing of corn, grain, and pulse, and all kinds of seed. Dated October 31, 1808. Specification to be enrolled within six months.

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THE

REPERTORY

OF

ARTS, MANUFACTURES,

AND

AGRICULTURE.

No. LXXX. SECOND SERIES. Jan. 1809.

Specification of the Patent granted to RICHARD FOTHERGILL, *of Sunderland, near the Sea, in the County of Durham, Schoolmaster, being one of the People called Quakers; for a Machine for dressing Hemp, and making and spinning the same into Ropes and Cordage.*

Dated April 12, 1793.—Term expired.

With a Plate.

TO all to whom these presents shall come, &c. Now KNOW YE, that in compliance with the said proviso, I the said Richard Fothergill do by these presents describe and ascertain the nature of my said invention, and in what manner the same is to be performed, as follows; that is to say: The machine, to be the better understood, may in idea be divided into seven parts: the first part or operation being to bruise, clean, open, and free the hemp from its native husk, so as to make it fit for the subsequent processes; the second, third, fourth, and fifth parts or operations of the machine being to dress and draw the hemp, and make it fit for spinning;

the sixth part or operation being to spin the same into thread or yarn; and the seventh and last part or operation of the machine, being the twisting and making the thread or yarn into ropes and cordage.

The first part of the machine is represented by the drawing marked Fig. 1, (Plate III.) signed and exhibited by me the said Richard Fothergill. A B C D E represent the frame; *a a a a a*, are fluted rollers, which may be made of cast metal or wood, of about ten inches diameter and eighteen inches in length, under which are an equal number of other fluted rollers *b b b b b*, of the same materials and size, so as to fit each other. If the upper rollers be of wood, they must be kept in close contact with the lower ones by means of weights attached to them. *e e e e e* are wheels, which may be made either of cast metal or malleable iron, and are fixed firmly upon the axles of the under-rollers. *f f f f* are other wheels moving on round studs, which studs are fixed into the iron plates *g g g g*, and which plates are fixed to the frame D E. P is a platform, on which the hemp *h* in its rough unmanufactured state is to be evenly spread, and by giving motion to any one of the wheels *e* the hemp will be taken through between the rollers *a a a a a*, *b b b b b*, and delivered at *x*. What is done by these rollers may also be performed by one large fluted cylinder acted upon by a proper number of small fluted rollers.

The second part or operation of the machine is represented by the drawing marked Fig. 2, also signed and exhibited by me the said Richard Fothergill: A B represent two wheels of about three feet diameter, and about twelve inches in breadth; at the sides of which are circular edges *b*, of mahogany, or other fine-grained wood, placed to prevent the hemp from falling over the sides of the wheels, and getting entangled with the machinery, and also to keep the hemp of an equal breadth upon the wheels, the edges projecting about three inches above the superficies. These wheels are planted with teeth (similar to those used in the common flax heckles) about two inches distance from each other: *f g h* represent wooden or metal rollers, which, with another roller under *g*, but prevented from appearing in the drawing by the wheels G H, act as feeders to those wheels, which are of the same size and dimensions as the two other wheels, but have their teeth placed closer together: C D F I *c n o p x x* represent pullies connected with the straps *k d i*, to give the wheels and rollers their proper and different velocities: *l* is a lever or bar to unlock the pulley D, and thereby to leave the rollers *f h* at liberty: behind the pulley *c* is another lever or bar to unlock the feeding wheel A, and at the same time to lock it into the pulley *x x*, represented by dotted lines at the end of the axle *a*. The strap *d* leads down to a pulley of about six inches diameter on the farthest end of the axle K, on which the pulley I and the two wheels G H are placed. The straps represented by S S from pulley I, and the straps represented by the dotted lines *y y*, lead to the mill. The axle K is round and longer by one half than the breadth of the two wheels G H, for the purpose of allowing them to slide backwards and forwards thereon, so that they may be alternately placed in a proper situation to feed the wheel or cylinder A in drawing Fig. 3, next hereinafter described.—The hemp, when brought from *x* in drawing Fig. 1 is put by the hand on the wheel A in drawing Fig. 2, which (being locked to the pulley *x x*) by the action of its teeth collects the hemp round itself till sufficiently filled. That wheel is then unlocked from the pulley *x x*, and locked to the pulley *c*, and the hemp wound round the wheel is then separated by the hand at an aperture left in the rim of the wheel, as at *e*, for that purpose, is then brought over the lower roller *h*, the upper roller *f* being first raised to admit it by means of the bar *t* fixed into the pieces of wood V V, into which the ends of the axle of the roller *f* are introduced. This being done, that roller is lowered to its former place, and the two hackling wheels G H are brought close to the pulley I by means of the slides *m m*, which pulley, and its axle, are now supposed to be in motion by means of the mill.—The pulley I has a projecting bolt or catch placed on the inside of it at *r*, which striking the bar *q* placed between the wheel G and the pulley I on a socket surrounding the axle, gives motion to the wheel which collects the hemp from the rollers *f h*, now supposed to be connected with the mill by locking the pulley D to the axle E. Whilst this process is performing, wheel B is collecting hemp in the same manner that wheel A had done before; and when the hackling wheel G has collected all the hemp from the feeding wheel A, through the rollers *f h*, it is slid back from pulley I with the hemp upon it, and forces the other hackling wheel H towards a smaller pulley at the opposite end of axle K, which pulley has a bolt or catch on the inside that strikes a bar in the same manner as pulley I, and the wheel H then collects the hemp from the wheel B through the roller *g*, and the roller under it in the same manner that wheel G received the contents of the wheel A through the rollers *f h*.

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The third part or operation of the machine is represented by the drawing Fig. 3, separated from drawing Fig. 2 by a dotted line. When wheel G has been slidden back on the axle, as before described, that wheel H may be filled from wheel B, wheel G will be in a direct line with wheel A in Fig. 3, in which *d* represents a small roller, A a plain wheel with circular edges on the sides of it to prevent the hemp from falling off, and to keep it collected. B *b* represents two rollers, the upper one being kept in close contact with the other by the weight C, and a similar weight at the other end. D represents a larger wheel without edges, but four or five inches broader than wheel A, planted across, and in regular rows, with teeth of the same kind, as before described. *l l* represent lifters, fixed by screws, on which they move into each side of the rim of the wheel D; and the lifters, which are opposite to one another, are connected by a thin lath, with holes in it to admit the teeth through them; *m* represents a piece of wood fixed firmly to the frame of the machine, and which, as the wheel D moves round, raises the lifters, as expressed by the dotted lines at *l*, and thereby delivers the hemp disentangled from the teeth between the fluted rollers E *n*, which are kept in close contact by two weights attached to a lever at each end of E. C represents a wheel with teeth and circular edges on each side of the rim. F *r* two rollers (the lower one only having circular edges at each end of it). represents a pulley which connects the machinery in drawing Fig. 3 to the mill by the strap *t t*. *s* represents a lever or bar which locks and unlocks pulley *q* to and from the machinery. *u p o g f v i h e* are pullies by which and the straps going over them the different velocities of the wheels and rollers are obtained. The rollers F *r* are either turned by the hand, or connected to the mill by a locking pulley on *r*. When the wheel G, in drawing Fig. 2, has received the contents of the feeding wheel A through the rollers *f h*, and is freed from the catch in the pulley I, and the hemp on wheel G is separated by the hand, as was before done with the hemp from the wheel A, drawing Fig. 2, and the small roller *d* in drawing Fig. 3 is thrown back, as represented by the dotted lines *a* (that roller being hung on a pivot for the purpose), the end of the hemp must be brought over the wheel A in drawing Fig. 3, which wheel, the rollers B *b*, and the wheel D, moving with an equal given velocity, the hemp is conducted regularly to the fluted rollers E *n*, which two rollers, moving with six times the velocity that the wheel D moves, will draw the hemp forward through the teeth *k k* over the laths of the lifters, and conduct it to the wheel C, which has edges and teeth the same as wheels G and H in drawing Fig. 2; the rollers E *n* moving with six times the velocity of the wheel D, will deliver the hemp to the wheel C, one sixth part of its former thickness, and six times the same length; and the same wheel moving with six times the velocity of the fluted rollers E *n* will draw the hemp in the same proportion, and hackle it at the same time: and from the hemp being drawn so much, it will be disposed with more regularity on the last mentioned wheel than is done by any former part of the machinery.—When the hemp has been thus collected on wheel C, it is taken therefrom (by being first separated with the hand, as was before done with the hemp on the wheels in drawing Fig. 2), by means of the small cylinders F *r*, and is then to be deposited in a box ready for the

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the next operation. Wheel D in drawing Fig. 3 may be of a smaller diameter, and placed higher in the frame.

The fourth part or operation of the machine is only a repetition of the process last before described on a machine of the same kind and dimension sas drawing Fig. 3, beginning at the wheel A, with the roller *d*, and ending with delivering the hemp at the rollers F *r*; but in the fourth operation of the machine the wheel C is to move with only one tenth part greater velocity than the fluted rollers E *n*, which may be effected by changing the size of the pullies.

The fifth part or operation of the machine is performed in the same manner as the fourth operation, from wheel A with the roller *d* to the fluted rollers E *n* in drawing Fig. 3; but when the hemp has passed through between those rollers, it is received therefrom, and thickened and compressed into a narrower breadth by a triangular piece of wood or metal with raised edges, being as broad as the rollers are long at the upper end, and narrowed regularly to about two or three inches at the point; or such compression may be made by rollers placed horizontally, vertically, or obliquely.

The sixth part or operation of the machine is the same as the fifth, but performed upon narrower wheels and shorter rollers, and when the hemp has passed through the triangular instrument for compressing it, or through the rollers used for that purpose, it is put through the pipe of the spindle at *a*, in Fig. 4, brought through one of the arms as at *d*, and fastened to the bobbin *fg*; these spindles must be increased according to the number of threads intended to be spun at one time. *m*, *n*, represent a toothed wheel on the top of the spindle for giving it motion, which is done by connecting wheels with a pulley as at *p*, in drawing Fig. 3, the size of which connecting wheels must be regulated by the coarseness or fineness of the thread intended to be spun; and the wheel *m n* will also communicate motion to other spindles by placing small wheels between them. In Fig. 4, *f g* represents the bobbin, *b c d e* the arms of the spindle fixed firmly thereto; *a b d*, the yarn leading (from the drawing machinery as before described) through the pipe or hollow pivot (which is kept in the proper position by a bush placed in the frame of the machine) at the top of the spindle at *a*, over the circular ring *b c*, through the end of the arm at *d*, to the bobbin, which is raised or lowered so as to receive the thread regularly, as expressed by the dotted lines *f*, by means of the bar *i*, which has an opening in it, as expressed by the dotted lines at *i*, for the purpose of taking the spindle out of the frame, and taking off the bobbin, and which bar is connected with levers, and regulated by a wheel nearly oval; *l* represents part of the frame in which the bush *k* is fixed; *h* is a friction pulley, to which the bobbin is fixed to prevent its being turned too quickly by the thread. The dotted lines *a* represent the part of the frame in which the hollow pivot of the spindle is placed. The seventh part or operation of the machine is represented by the drawing Fig. 5. A B C D E F G H I J K represent the frame; upon a cross bar between the middle of the rails F and G (but which is prevented from appearing in the drawing by the cog wheel 3) is erected a strong immoveable shaft of iron, the other end of which is introduced into the circular top or plain wheel 7 1; on the said shaft near the bottom is fixed the immoveable toothed wheel 2, and under that wheel is placed the said moveable cog wheel

3, on a part of the said shaft which is round. Upon this wheel are placed three pillars represented by 4, 5, 6, supporting the circular top or plain wheel 71, which is kept steady by the iron shaft, on the upper part of which it moves; 8, 10, 12, represent small wheels, the axles of which are received into holes near the outer edge of the wheel 3, and move freely therein at equal distances from the pillars. Between each of the smaller wheels and the immoveable wheel 2 are placed connecting wheels represented by 9, 11, 13; on the top of each of the wheels 8, 10, 12, are fixed frames *a b c d*, *a b c*, *a b d*, containing the bobbins *e f*, *e f*, *e f*, on which the threads or yarns are wound. *g g g* are springs connected by a screw in the middle of each to a cross bar *h h h* in each of the frames; from each end of these springs proceeds a cord, which, after going round the head of the bobbin, is fixed at the other end by a staple into the side of the frame, in order to retard the motion of the bobbins, and keep the strands of the rope properly stretched. From the bobbins the yarn passes through a hole in the centre of the cross bars *h h h*, and round the regulating pullies *i i i*, through the hollow axle of the wheels *j j*, and another wheel of the same kind and size, but which cannot appear in the drawing, and after passing over the pullies *k k* and another of the same kind, but which cannot appear, the yarn proceeds to where the three strands unite to form the rope at *l*, which leads over the pulley M, and round the pulley N (which has an indented groove) to L. O represents a pulley, which is carried round by the strap V V from the mill; on the further end of its axle is fixed the double spur wheel U, having one set of teeth pitched into the wheel P (which gives motion to the pulley N by means of the wheels Q R T, and the perpetual screw S), and the other set of teeth of the wheel U being pitched into the cog wheel 3, which is by this means driven round on the upright iron shaft, and so lays the strands of the rope together at *l*; and as this motion of the cog wheel 3 carries the connecting wheels round the fixed wheel 2, into which they are pitched, they will turn round in the same direction as the cog wheel 3, and give motion to the spur wheels 8, 10, 12, and the frames connected therewith, in a contrary direction, and thereby twist the strands which form the rope at *l*, and are drawn over the pulley M as before described. In the groove of each of the regulating pullies *i* is a small friction wheel *m*, the axle of which moves at *n n*: this wheel is drawn close to the yarns or threads, to keep them from sliding on the pulleys, by the screws O O; to one side of each of the regulating pullies *i* are fixed small bevil wheels (one of which appears at *t*) and these are pitched into three bevil horizontal wheels represented by the letter *s*; on the same axles are fixed three spur wheels *q*, which wheels are pitched into the three spur wheels *j*, which move on the hollow axles before mentioned. The last mentioned wheels are pitched into one large spur wheel *r*, placed on a round part near the top of the upright iron shaft, and moving freely round the same. By means of these wheels the regulating pullies *i* move with equal velocities. *u* is a screw placed against the end of the axle on which the wheel C is fixed for pitching that wheel into the spur wheel Q, which wheel may be greater or less, according to the size of the rope, or the tightness of the twist required. The drawings Figs. 1, 2, and 3, are upon a scale of one inch and an half to a foot, and the spindle Fig. 4, and the whole of drawing Fig. 5, are upon a scale

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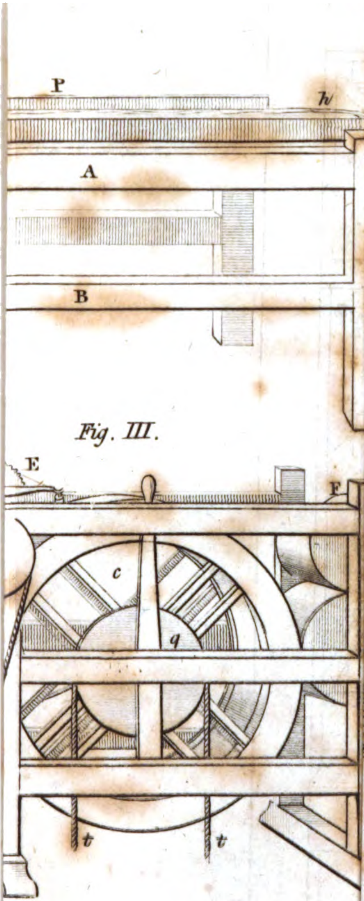
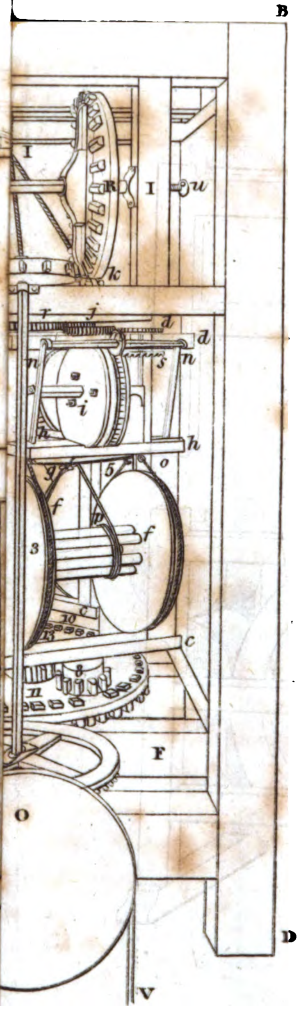


Fig. III.

Fig. V.



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scale of two inches to a foot *. The pullies which in any part of the machine are connected by straps, are intended to represent the means by which the different parts of the machine have their connection and proper degree of velocity. It is to be understood, that when the different degrees of velocity proper for the wheels and rollers which act immeditely on the hemp are mentioned, the velocities of their respective superficies on which the hemp, yarn, or rope act, are meant; when any part is mentioned as connected with the mill, a reference is intended to any power given by hand, horse, water or steam, or by any other means. In witness whereof, &c.

Specification of the Patent granted to JOHN DICKINSON, *of St. Martin Ludgate, in the City of London, Stationer; for his Invention of a Cannon Cartridge Paper, manufactured on an improved Principle.*

Dated November 12, 1807.

TO all to whom these presents shall come, &c. NOW KNOW YE, that in compliance with the said proviso, I the said John Dickinson do hereby declare that my said invention is described in manner following; that is to say, My invention consists in the addition of a certain proportion of wool or woollen rags to the linen rags or other materials, consisting of hemp or flax, that have hitherto been made use of for manufacturing this kind of paper; by means of which, in consequence of the intermixture of the woollen fibres with those of the hemp or flax, when the paper is lighted by the explosion of the powder in the gun, it is prevented from retaining sparks of fire after the flame goes out; the mixture should consist of about two fifths woollen, and three fifths linen, or some other fabric composed of hemp or flax. The linen and the woollen should be washed and made into half stuff in separate engines, and afterwards mixed in their proper proportions, and beat together in the beating engine. But if wool is made use of, or woollen rags that are of a very loose texture, they may, in that case, be washed in the same washing engine with the linen, as well as beat off together in the same beating engine. The woollens require a roll, the bars of which must be so round or dull that they will not cut, otherwise any close-woven rags will be chopped up into small pieces; of course the roll must be heavy, or the process of making them only half stuff will be very tedious. The linen should be very strong and sound, and beat as wet, and at the same time as long as possible, otherwise with the proportions mentioned above, the paper will not be sufficiently strong. The greater quantity of woollen there is introduced, the more effectually will the paper be prevented hanging fire; but, as it contributes very little to the strength of the paper, it would not be practicable to use a larger proportion than what is mentioned above, except the linen materials were new and particularly strong. On the other hand, a smaller quantity of woollen would, in a less degree, produce the effect of preventing the paper hanging fire; while, from containing more linen, it would possess greater strength; but I consider the above proportion most eligible, and combining (if the paper is properly manufactured) a sufficient degree of strength, with the property of not retaining fire. The paper should be "engine sized" with alum only, in the proportion of about ten pounds to one hundred and twelve pounds of stuff, and no oil or spirits of vitriol, or any other ingredients, should be put into the engine. The paper should not be picked. This paper is adapted to be cured in the usual manner previous to being made use of.

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* In the original drawings, which have been considerably reduced to suit the size of this work.

In witness whereof, &c.

Specification of the Patent granted to ARCHIBALD JONES, *of Mile-End, in the Parish of Stepney, in the County of Middlesex, Printer; for a Method of discharging Colours from Shawls, and other dyed Silks, and Silk and Worsted of every Description, or such Part or Parts thereof as may be required for the Purpose of introducing, by printing or staining, various Patterns on such Discharges, or otherwise.* Dated October 7, 1806.

TO all to whom these presents shall come, &c. NOW KNOW YE, that in compliance with the said proviso, I the said Archibald Jones do hereby declare that my said invention is described in manner following; that is to say:

Take one pint *aquæ fortis*, or nitre fortis, more or less, and add thereto one pint of water, more or less, according to the patterns to be printed, thickened with flour, or any other proper substance, to such a consistency as may be proper for the blocks with which they are to be printed. After being printed put them into a steam or steaming box, and continue the articles therein until the discharge is brought out, which in general is produced in about five minutes: then take such goods out of the steam, rinse and dry them, and they are finished. In some instances, where the goods do not require it, I do without steam.

In witness whereof, &c.

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Specification of the Patent granted to CHARLES GRANT *Viscount de Vaux; of Elizabeth Street, Hans Square, in the Parish of St. Luke, Chelsea, in the County of Middlesex; for a Machine, which will shew the Latitude and Longitude at Sea; serving also for weighing any Object, for measuring Space, or the Course of a Ship, and Time, shewing and keeping Account upon Dials, and upon Cosmographical Columns, which are Part of such Machine; and also shewing the Leeway of a Ship: Part of which Machine may also be applied to other useful Purposes.* Dated December 9, 1807.

With a Plate.

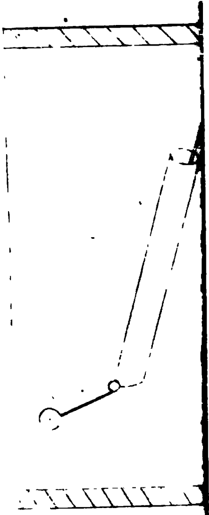
TO all to whom these presents shall come, &c. NOW KNOW YE, that in compliance with the said proviso, I the said Charles Grant, Viscount de Vaux, do hereby declare that my said invention is described in and by the drawings hereunto annexed, and the following description thereof; that is to say: The hydroscope itself which is a double box suspended one in the other, and supported by an axis or horizontal pivot *n* (Fig. 1, Plate IV.) hollowed in the inside, which keeps the two boxes perpendicular in all the motions of the ship. The inside box *z* contains a sort of clepsydra, or double sandglass, furnished with one or two perpendicular scales *q q*; by means of these scales, which cover the two sandglasses *o* and *p*, the weight of the sand, falling in due proportion on the bottom one, acts upon a spiral ring fixed perpendicularly in the top of the largest box, to which it is joined by some wires *x x* and a hook *r*, placed in the centre of each scale: by these means the weight of the sand fallen in a certain time expresses upon a dial in front of the top box, and divided into sixty parts, or minutes of degree, the quantity of miles run by a ship, according to its velocity. But the continual variation of that velocity is expressed upon another dial *l* placed upon the side of the frame *v*, which supports the double box, because a globe *a*, six inches diameter, and of an equal weight with the same cube of water, is plunged in the sea, the medium of the ship. This globe *a* has a communication to the inside of a room *c* in the ship (where the hydroscope stands) by a cord or chain *b* through a cylinder *e*. The cord or chain passing over a pulley or crank *f* enters in the tube or pivot *n* of the boxes *y* and *z*. In this tube the chain joins a band or rod of brass *m*, which passes through the brass collar *k*, in which the sand descends from the glass *o* to the glass *p*, *vice versa*. This band of brass *m* has a longitudinal opening equal to the extent of the attraction of the globe upon another spiral spring *d*, placed horizontally in the same tube on the other side of the brass collar *k*, so that the greatest velocity of a ship being supposed to be twelve miles in an hour, the ship going at that rate, a globe of six inches diameter cannot receive in the water a greater resistance than twelve pounds, or one pound per mile, as the spiral spring shews upon its rod. The rod of the spiral spring expressing twelve pounds, or twelve miles, not coming out of the spring more than four-tenths of an inch for that weight, or for that resistance of the water upon the globe than the longitudinal opening made in the above band or rod *m*, which, as I have said, passes through the brass neck or communication between the two glasses, does not let the sand pass or fall according to the velocity of the ship, and stops it entirely if the ship is at rest. But if this machine or hydroscope is used on land instead of the sea, or in a ship merely for a time-keeper, then the sand will always run at the same rate, and express regularly the time upon the interior circle of the dial *l*, divided in twenty-four parts, and it will be sufficient to wind it; that is to say, to turn the box or clepsydra, every twenty-four hours.

Secondly, By the same principles of this weighing-clock the same dial *l*, which serves on the side of the hydroscope for weighing the resistance of the fluid, or the run of a ship, if this dial is taken separately, with its spiral spring, is a convenient machine to use instead of scales for weighing any goods or commodities in a family, house, or in any shop; it requires no weights, nor any other scales; it never entangles like the scales, and is as sure and convenient as it is ornamental. On the other hand, this simple machine, the dial and spring, will become an excellent perpetual log when the globe is used with it; and with a wheel work like a jack, put in motion by a spring or a weight, as mentioned in the second part of my hydroscope (see Fig. 2), this same jack or wheel work can serve to measure the strength of the wind, in which case the above clepsydra, article first, or sand-clock, would be used separately as a good time-keeper.

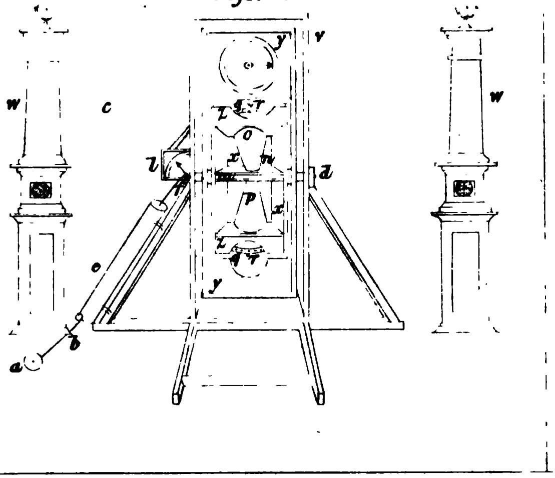
Thirdly, The columns *w w*, or frame annexed to the above parts of this invention, being the one terrestrial and the other celestial, they serve to mark the situation of the ship in latitude and longitude, upon the first relatively to the earth, and upon the second relatively to the sky; consequently they offer an useful and interesting journal during all the voyage, if care is taken to fix each of the cylinders of these columns every day with a pin or screw, according to the result of the above machine to which these columns belong.

Fourthly,

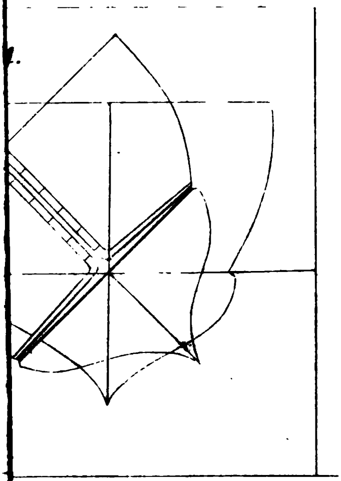
Pl. IV. Vol. XIV. Second Series.

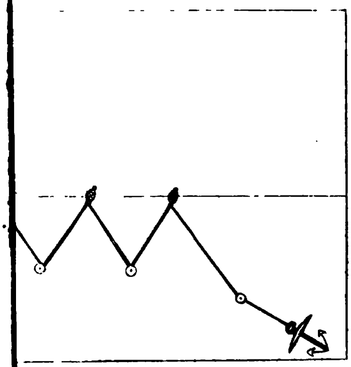


Figs. 1.



1.





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Fourthly. The third part of this invention is the elastic cable and remorator, Fig. 3, for stopping the ship or boat in a current at sea, in order to calculate the alteration that such current can occasion on the course of the ship, as these elastic cables, or remorators, can be used in a small scale, with a boat, as well as with the ship. It is always easy to know by these means what is the strength and direction of a current, if any, and to calculate the course of the ship accordingly.

Fifthly. As it remains to deduce from the course of the ship another effect, called the lee-way, this effect is accounted for in this invention for the longitude by the means of a little glass tube Fig. 4, such as for a barometer. This glass-tube is fixed across the ship to a little opening or valve on each side very little under the level of the water: the centre of that rises perpendicularly along the frame of the hydroscope, where a scale graduated expresses the degree of the lee way of the ship by the water rising in that perpendicular glass tube in the proportion of that effect called the lee-way, then it is very easy to join this account to the precedent. In fine, as this combined machine can be put in motion by water, as well as by sand or wheels, the same means I employ to measure the lee-way of a ship can serve to measure her direct velocity or course, if a little trap or valve is adapted to the opening made on the sides of the ship for the small tube of the lee-way.

N. B. It is by the re-union of these means, on the same principles, and on the same plan (which is the object of this patent), how the longitude and latitude of a ship can be found.

In witness whereof, &c.

OBSERVATIONS BY THE PATENTEE.

Having perused, in the LXIst Number of the Repertory, for June 1807, an account of a method of ascertaining the rate of the velocity of a ship under sail, by Mr. Boswell, which is much like what I have described in one part of the specification of a patent I have obtained, I was induced to express my astonishment at this extraordinary coincidence in a note at the end of the work, "*On the Means of finding the Longitude at Sea;*" which I published in the beginning of the present year 1808. As Mr. Boswell has thought proper to notice, in the LXXVIth Number of the Repertory, for September, 1808, the observations I made in that note, I have to request, that the insertion of the Specification of my Patent in the Repertory may be accompanied with the following narrative of circumstances, tending to shew my claim to the invention long before the appearance of Mr. Boswell's account of it in the Repertory.

After many years of study, researches, and extensive writing on these subjects, I began by publishing part of them, in the year 1801 and 1802. This first publication contained my new division of the World in 8vo, with four maps; the last page being the prospectus for publishing by subscription, an Enquiry into the History of *Navigation*, from the earliest period, with different new machines of my invention, in order to facilitate to navigators the means of *finding the Longitude at sea*, for which I took *a caveat.* The principal MS. on these last subjects were deposited by me in the hands of Messrs. Cadell and Davies, in presence of Dr. G. for future publication; but I took them again, in order to submit them to the Admiralty, to the Board of Longitude,

tude, and to the East India Company, in the course of the years 1803, 1804, 1805, and 1806.

The first answer I received from the Board of Longitude *on the means of finding the Longitude by the rate of sailing of a ship*, was a letter from Mr. Gilpin, Secretary of this Board, dated June 9, 1806, the tenor of which is as follows:

"Sir, Your papers addressed to the Commissioners of Longitude, on a method of ascertaining the rate of a ship at sea, &c. were laid before the Commissioners on Thursday last, and are under consideration.

I am, Sir, &c. GILPIN."

N. B. This letter, with the certificate of Dr. Mackay on the same subject, were both immediately printed, and made public as follows:

"Having perused an account of an instrument invented by General Grant, Viscount de Vaux, called a new Hydroscope, for the purpose of ascertaining a ship's rate of sailing with more accuracy than it is possible to be done by the common log, and consequently to determine the Latitude and *Longitude* of the ships with much greater precision than has hitherto been done by dead reckoning; I am of opinion the above-mentioned invention of the Viscount de Vaux will, when put in practice, be found of great utility in *determining the true place of a ship.* Its preference to the log will be obvious to any person in the least acquainted with maritime affairs.

A. MACKAY,

Mathematical Examiner of Trinity-house, of Christ's Hospital, of the East India Company, &c. May 6, 1806."

But, not having since received any satisfactory answer from the Board of Longitude, I was advised to take a patent, and to publish my work afterwards: in consequence, I had the machinery constructed in the preceding years, and my work on that subject printed, in the beginning of the year 1807; but I put off the publication of it, until I had procured my patent. I was therefore greatly astonished when I saw in the Repertory of June 1807, apparently, a short extract of the first chapter of my plan, which had been printed by Mr. Shury, of Berwick Street, long before the appearance of that paper in the Repertory, which resembled some part of my invention.

In consequence, I printed at the end of my work the following note:

"At the moment these sheets are about to make their appearance in public, a pamphlet has been put into my hand, in which I find an account of some of my instruments, given, almost *verbatim*, by a writer in the Repertory of Arts as his own invention, (see No. LXI of that publication for June 1807.) It is hardly possible for a reviewer to give a more accurate sketch of a part of my work than has been done in that paper, except the addition of a stick which this writer proposes to pass through the powers I place in the water—an addition which can be of no use.

"To what resource he is indebted for *his discovery* the public may judge, by comparing his account with the description I have given in my work of the instrument, long since communicated to men of science, to some of the official boards, the result of thirty years of study, research, and experiment. *This writer* invites some unprejudiced commanders to attend *to the method*, and to publish the result of their experiments. I had myself communicated *this part* of my plan to *Lord Minto*, a short time previous to his departure for India, for the purpose of his trying it on his passage. It is now more than four years since I laid my plan on Longitude, &c. with its progressive improvements, before the Admiralty, and it has been more than three years before the East India Company, the Board of Longitude, &c. The India Company have appointed three referees, Dr. Mackay, Capt. Huddart, and Mr. Gwynen of Christ's Hospital, to judge of it.

"It is well known that being so situated, it was not in my power to have my work published, though it was printed."

Mr. Boswell seeing this note, stated in the Repertory, No. LXXVI. for September, the following assertion concerning me:

"*I take this opportunity to beg leave to notice a strange assertion, made in a treatise on finding the Longitude, published by a French Count. He accuses me of borrowing the plan from him, through the medium of a certain noble Lord, or the Lords of the Admiralty, who,* HE SAYS, *betrayed his secret to me.*"

On referring to my note, of which a copy is given above, it will be seen that Mr. Boswell is very incorrect in asserting that Lord Minto or the Lords of the Admiralty had betrayed my secret to him. I certainly neither meant nor said any such thing; my mention of Lord Minto and the Admiralty was merely to shew the respectability of my proof of the anteriority of my invention.

Method adopted by BENJAMIN ROEBUCK, *Esquire, to make Ice at Madras. Communicated by a Correspondent.*

Description of the Apparatus.

HE has two tubs of a common shape, the diameter at the surface 32 inches, and 26 inches at the bottom, their depth is 25 inches; and two vessels of thin copper tinned, which are placed in these tubs, their diameters at top are 25½ inches, bottom 24; their depth is 23½ inches. He has also two vessels of the same substance, which he places in these two copper-tinned vessels, having placed wool or hair between the bottoms of each, as also on the sides, to prevent as much as possible the communication of heat from the external vessels; their dimensions are, at top 23¼ inches, at bottom 22, and depth 22 inches. For the sake of perspicuity in this description, one wooden tub is named A and the other B; one of the tinned vessels AO and the other tinned vessel BO. The vessels which are to contain the mixture, are in this description called tinned vessel A and tinned vessel B.

He has a circular frame which is put into the tinned vessels A and B, and which has seven holes, so that it will contain seven tinned vessels, each of which will hold more than 16lb. of water; their length is 22 inches, their diameter is 6 inches; there is no occasion to have the bottom frame on which they receive the circular motion perforated. He has also a tinned vessel C, whose dimensions are 15 inches diameter, depth 23½ inches, and a tinned vessel D, whose dimensions are at top, diameter 12 inches, bottom 10, depth 20¼ inches; and in this he has a frame of tin, so that he can give the tubes he puts in it a circular motion. Across the tinned vessel C he has a slight wooden frame, as it is necessary, in the last operation hereafter described, to tie it down to the wooden vessel B. Hair or wool is put at the bottom of C, to prevent its communicating external heat. The tops of all are covered with country cumblies, eight folds thick. The copper-tinned vessel AO is placed in the wooden tub, which has a hole in it to let out a screw tube soldered to AO, 2 inches diameter. When this is put in, he caulks round the brass tube to prevent leakage. His tinned vessel A has also a tube, which goes through the tube of AO 1½ inch diameter, on which he has a screw with a leather washer to make it water-tight. None of the substances in one vessel can therefore communicate with the other; and the tinned vessel AO is always kept dry on the inside.

The tubes for freezing the mixture are at 19¾ inches long, 1½ diameter at top, and 1 inch at bottom.

Process.

The materials used are salt petre and sal ammoniac; the proportions are equal quantities of each, as ascertained by Mr. Walker, and in the proportion of 5lb. of each substance to 16lb. of water. He has taken Mr. Walker's proportions for granted, as the best. In the hottest season of the year, when the thermometer at night is 90, and a land wind blows, water which has been exposed in the common earthen porous pots used at Madras and throughout the Carnatic, will be about 10 degrees below the heat of the atmosphere, and be 80 degrees. By keeping the sal ammoniac pounded in metal vessels, and in water contained in earthen porous vessels, these substances will be cooled to the same degree. The vessels B and vessels BO and B are to finish the process; he therefore wishes to have them as cool as possible in the first instance: and he puts water which is 10 degrees colder than the atmosphere into the wooden vessel B at the commencement of the operation: the same may also be done with the wooden vessl A.

In the very hot weather he always prefers four operations, beginning the first with his evaporated substances as follows: put into the tinned vessel A five of the tin vessels, each containing 16lb. of good water; put into tinned vessel B seven tin vessels each containing 16lb. of good water, the purer and freer from earth or salt the better; put into each of these tinned vessels A and B, 50lb. of old stuff, that is, sal ammoniac and saltpetre once used and evaporated, and about 90 or 95lb. of water, as much water as will admit the circular motion to take place without any chance of injuring the purity of the water in the five vessels in A and the seven vessels in B. In the first operation instead of old stuff, he uses the same quantity of saltpetre. In about two hours the water in the small vessels and the cooling mixture are at an equilibrium of heat. He then takes out the water from the wooden vessel B, and substitutes the cool mixture which has been in the tinned vessel B. He takes out as speedily as possible the five vessels of water from the tinned vessel A, and puts them into the tinned vessel B, and to this 80 pounds of water he adds 25 pounds of pounded sal ammoniac, and 25 pounds of pounded saltpetre. The change takes about five minutes, and this operation requires one hour and three quarters. When he has taken the water vessels out of the tinned vessel A, he puts the saltpetre and the sal ammoniac, being 10lb. of each, for the last operation, into the tinned vessel A to be made cool; and he also puts the substances he means to freeze into the same vessel for the same purpose. At the end of an hour and three quarters he draws off the water from the wooden vessel B, and replaces it by the salts and water in the tinned vessel B. He then takes five of the water vessels out of the tinned vessel B, and pours the contents into the tinned vessel B. He also adds the same quantities of salt-petre and sal ammoniac as before, being 25 lb. of each. He takes the two vessels containing 10lb. of salts from the tinned vessel A, and places them in the tinned vessel B. He also takes out all the vessels containing the substances to be frozen, and places them in the tinned vessel B. The tinned vessel B then contains two vessels of water, two of salts, and all the intended ices.—This operation takes also one hour and three quarters, and at the end of that time there are large quantities of ice above half an inch thick in the two water vessels, and he believes the ices are nearly frozen. At this period he takes out the apparatus which gives the circular motion, and places the vessel C and D in the vessel B. He always puts the vessel D into the last mixture in B, to make it as cool as ice before he puts the last mixture in it. He then puts into the vessel D all his vessels containing ices, and puts among them 10 lb. of saltpetre and 10 lb. of sal ammoniac, and pours out the water from the two vessels and the ice which they contain into D: D then contains 32 lb. of water and ice, and 20 lb. of saltpetre and sal ammoniac, in equal quantities, and all the tin-tubes. Mr. R. then turns them gently round. This operation will be completed in one hour and three quarters, and the ice ready for use. None of the changes, if properly done, take more than five minutes.

Remarks.

It is to be observed, that the salts once used may be evaporated to dryness, but they no longer possess the same power of producing cold, as they lose one fourth of their effect. Sixteen parts of water by weight, and five of sal ammoniac and five of saltpetre, will reduce the temperature forty degrees; but, when these substances are re-produced in a joint body after solution, they only reduce the temperature thirty degrees. In the course of the evaporation and exsiccation there are some very curious phænomena, which will not escape the attentive chemist, and which he will find it very difficult to account for: the subject is worthy of, and requires much investigation. He will also perceive a very considerable diminution in the quantities of the salts which he has reproduced by evaporation, which he will very easily account for.

A Treatise on the Diseases of Sheep; drawn up from original Communications presented to the Highland Society of Scotland.

By ANDREW DUNCAN, *Jun. M.D. F.R.S.E. and A.L.S.L.*

From the PRIZE ESSAYS and TRANSACTIONS of the HIGHLAND SOCIETY of SCOTLAND.

IN the year 1803, the Highland Society of Scotland, with the view of collecting information relative to a most important national object, published the following notice:

"A gold medal or piece of plate of forty guineas value, will be given to the person who shall, on or before the 20th of November 1804, lodge with the depute secretary of this Society the best and approved essay or communication,

"On the accidents and disorders to which sheep are liable, and particularly on those destructive diseases to which, in many situations and seasons, they are incident, called in different parts of Scotland, the one by the name of *braxy*, or *braxit*, or the *sickness;* and the other by that of *rot*, or the *poke*, &c. On the varieties or different kinds of these disorders, the causes inducing them, and the means of preventing, or removing them, in different cases."

To which they subjoined the following judicious note:

"As there is reason to apprehend, that disorders of different sorts are included under each of these two general names, the Society wish that, so far as may be useful, a description shall be given of the appearances which occur on opening the body of animals afflicted with any of these distempers."

The laudable object of the Society in promulgating this question, was attained in as great a degree as could have been expected. Besides several shorter communications, no less than ten essays of considerable length were transmitted to them, each of which received some mark of the approbation of the Society, although no one of them was so complete in itself, or so superior to the others, as to be deemed worthy of the whole prize. For the same reasons, they resolved not to print one or more of these essays intire in their Transactions; but to put the whole into the hands of some professional gentleman, who, by collating them carefully, might arrange the original and valuable information thus collected into one general treatise. With this view, thirteen essays on

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diseases of sheep were put into my hands, which the Society had received from the following gentlemen:

1. By Mr. William Hog, of Mension. 2. By the Rev. Mr. Singers, at Kirkpatrick. 3. By Mr. Robert Stevenson, Surgeon, at Gilmerton. 4. By Mr. Alexander Welsh, Easter Harestain. 5. By Mr. Thomas Beattie, Muckledale. 5. By Mr. Walter Scott, Etterick House, Selkirkshire. 7. By Mr. James Hog, Mitchel Slacks. 8. By Mr. William Hog, at Mension. 9. By Mr. Walter Scott, Etterick House, Selkirkshire. 10. By Mr. Alexander Laidlaw, Bourhope. 11. Two short communications, from Mr. Campbell, of Ormadale. 12. By Mr. James Anderson, of Airsdale. 13. From a gentleman in Northumberland.

Of these materials is the treatise which I now have the honour of presenting to the Society entirely composed. I neither thought it proper, nor did I find it necessary, to consult any other source of information. It therefore does not contain a single fact or observation which is not inserted on the authority of one or more of these essays. In composing it I have preferred that arrangement which appeared to me most natural, not that which was most scientific; and I have endeavoured to render the style popular and perspicuous. But while I have omitted no fact or observation connected with the subject of this treatise, I have rejected from it every speculation, however ingenious, as they would only lessen its value, in proportion as they increased its length. In an appendix, however, I have inserted several important digressions, and various scientific classifications, that nothing might be altogether omitted, by which our knowledge of the diseases to which sheep are liable in this country might be increased, and the means of preventing them rendered more perfect.

Lambing.—The lamb when newly dropt is feeble and defenceless, and in its domesticated state would often perish, but for the fostering care and provident attention of man. Its size, as well as the frequency of twins, is influenced both by the condition of the ewe, and vigour of the ram. A flock which is fed well at rutting time, and which pastures easily, produces a much larger proportion of twins, than one whose walk is higher and colder, and which feeds more upon heath. Twins are also most frequent in the commencement of the lambing season; the produce of the ram before his vigour is impaired. Hence the propriety of keeping the ewes in good condition, and of not giving a larger number to the ram than he is able properly to serve.

To prevent irregular lambing, the rams must be kept in a strong inclosure, until about the twenty-second of November, when they may be admitted to the old ewes, and some time afterwards, to the gimmers or young ewes; so that the period of gestation being twenty-one weeks, the lambing season may commence about the middle of April. If postponed longer the ewes will not have time to recruit before the approach of winter, and the lambs would not be soon enough ready for the market; while, on the other hand, if admitted sooner, the loss would be very great, both from the severity of the weather, and the want of proper pasture.

When the lambing season approaches, the shepherd must be attentive to keep his flock at home, and prevent others from encroaching on their pasture. If the ground be rough, he must see that none perish in holes or other dangerous places. Immediately before they begin to drop their lambs, Mr. Laidlaw is of opinion that they should be carefully folded, and a small quantity of wool pulled from their udders, to give the lamb more easy access to the teats; but others condemn this practice of udder-locking, as unnecessary and dangerous. Mr. James Hog mentions an instance, where, in his opinion, it occasioned the death of one twentieth of the ewes, while many of the survivors lambed dead lambs, at the danger of their own lives. "Nature," he adds, "has left a sufficient space bare to enable the young lamb to find the dug, and the uncovering of more serves only to starve them in the most tender parts; for, though I have been engaged amongst sheep all my life, I never saw one lamb die for lack of its dam being udder-locked; nay, let her be as young or as rough as she will: nor did I ever meet with the man who could aver that he had seen any. Whether the Cheviot lambs are easier killed this way, or if owing to the shape of their dams, they are more exposed, I cannot tell, but far less hurt will make that breed lamb dead lambs than the forest breed." When the lambs begin to drop, the greatest attention is absolutely necessary. The ewe being greatly debilitated by the severity of winter, and the pains incident to parturition, will be very apt to go wrong, and die, if neglected. In certain circumstances, she will even be unable to lamb without assistance. When any ewe is observed to rise with difficulty, especially if she be dirty about the tail, she must be attended to; and, if necessary, the lamb taken from her with as much skill and tenderness as possible. It is also advisable to place her in a well-sheltered situation, till her recovery be no longer doubtful.

If lambs be healthy, and the weather good, in the course of five, or even two, minutes, they begin diligently to search for suck; and after getting it, they seldom perish from cold. But the inclemency of the weather not unfrequently kills them before they reach the ground. It is, however, less fatal to the lambs of the short black-faced sheep, which have a fleece to cover them, than to others, which are generally naked when dropt; and the loss, from this cause, is in a great measure owing to the want of proper shelter, which should be supplied by planting trees, or at least by building walls in proper situations, to which the shepherd should drive or carry such lambs and ewes as are in danger. He should also carefully observe the point from which the wind is likely to blow, when the storm commences, and conduct his flock to the least exposed situation.

One man is sufficient to attend four hundred ewes, when the season is moderate, and other circumstances are favourable.

For the first fourteen days, lambs depend entirely on milk for their sustenance, although they may be seen nipping the grass, after ten or twelve days. During this period, they make the most rapid advances towards bulk and strength. They are wanton and playful, and fond of coursing in detached parties round some mound or hillock. But even in this state there are some diseases peculiar to them, of which the most frequent, if disease it can be called, is hunger.

Hunger.—A lamb perishing from hunger is easily known. It appears very hollow at the flanks, has a weak and mournful cry, is very apt to follow any sheep that comes nearest to it, and is either unattended by its mother, or if it attempt to suck her, she springs forward;

and will not suffer it to touch her. In all these circumstances, the lamb, and its mother, which, if not with it, may be easily discovered among the neighbouring sheep, by being thin about the flank, dirty about the tail, and feeble in its walk and bleat, should be immediately put into an inclosure, where her behaviour and disposition towards her lamb will be more directly under inspection. On examination, it will be found that the tips of her nipples are sore, or that she has no milk. In the former case, some mild and emollient ointment, such as simple cerate, may be applied to them; and in the latter, the ewe must be supplied with plenty of green pasture, when, in general, she will soon have abundance of milk, and nurse her lamb kindly. During this time the lamb must be frequently fed with ewes milk, but after it has been permitted to suck, both ewe and lamb should immediately be liberated. On a sheep-farm of considerable extent, it is an incalculable advantage, especially during the lambing season, to possess an inclosure of an acre or two of sound and early pasture, with the folds and smearing-house in some corner of it. In a bad season it will repay half the expense of inclosing.

The carcase of a lamb which dies of hunger is entirely wasted; instead of fat it has a toughish white substance, of a totally different nature, and instead of the curdled milk which is always found in the stomach of a healthy sucking lamb, there is only a little watery phlegm with some air.

Ewes which lose their lambs may be advantageously employed to divide the fatigue of nursing with those which have twins, and to rear the lambs of hogs, small gimmers, or very lean sheep which have not a sufficient supply of milk. By covering the lamb to be adopted with the skin of the dead lamb, and confining it with the ewe, as directed in the case of deserted lambs, it will be at last permitted to suck, after which it runs no hazard of being repulsed or deserted.

Milk.—A lamb is said to be sick of the *milk* when it appears quite spiritless and dull, with its ears, instead of being upright, lying asunder on its head, is very lank in the sides and belly, and its breathing is short and unequal. These symptoms are succeeded by a purging of a yellowish milky coloured matter, which has sometimes come on before the disease be observed. At other times they die without having had any, or only a little discharge of excrement. The carcase appears well fed; the excrement in the intestines, which are somewhat swelled, resembles in colour that passed at the anus, while the stomach is particularly full of coagulated milk.

This disease never appears in a hard season, but only when the weather is warm, genial, and growing, and there is great plenty of new grass. It does not affect them after they are three weeks old, and is ascribed to their sucking more milk than they can digest; nay, it is even said, that they not unfrequently suck until their stomach burst. As they are young, and consequently of little value, no remedies or preventives are ever tried.

Pinding is another disease exclusively confined to sucking lambs. Before they begin to eat grass, the excrement is of a tough adhesive nature, part of which sticks to the tail and buttocks, and when hardened by the sun, sometimes glues them together so closely, that there is no possibility of any evacuation, and the intestines soon mortify and burst. The disease is easily discovered, by the lamb appearing swelled and sick, with

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the upper and middle part of its tail closely glued down, and is as easily cured, by separating the tail from the buttocks, when the retained excrement is discharged with an offensive smell. Its immediate recurrence is prevented by rubbing the parts over with friable clay or mud; but they should be looked after for eight or ten days, until they begin to eat grass, when all danger from this obstruction is over. It is most dangerous when the ewes are in high condition, and the season dry and backward; and seldom or never appears when the mothers are lean and the weather wet.

Inflammation of the Bladder.—During the first ten days of their life, a few of the males will also die of inflammation of the bladder. But this only happens in cold and barren weather, when they lie too long in one place. To this, therefore, the shepherd must also be attentive; and by proper attention to the weak and exhausted lambs they will frequently recover, especially if they fall a trembling.

Grass ill.—When about three weeks old, and beginning to make grass a part of their food, especially if it be coming in great plenty, a straggling lamb or two will sometimes die of what is called the *grass ill*, which, both from its symptoms, its speedy termination in death, and the appearances on dissection, seems to be a species of the sickness to be described hereafter, to which the affection last noticed also belongs.

Stiff Joints.—During the month of June, a few lambs in a flock will sometimes be seized with stiffness in the joints, occasioned by the low state of the dam. At that time they are disposed to grow very fast, but for want of proper nourishment they become stunted, and their joints swell, but they generally recover.

Louping ill.—There is sometimes a considerable loss of lambs, by what is called the *louping ill*, which is an affection of a paralytic nature, sometimes lingering, sometimes so speedy, that they are often dead before the disease is suspected. Washing in cold water has been used with considerable success.

Castration.—When they are about eight weeks old, the tup lambs are castrated, which is a painful, and frequently a fatal operation. If possible, it should never be done when there is electricity in the atmosphere, when the nights are frosty, or when it rains heavily; but in clear mild weather, or during mild thaw. New built folds, with those resorted to by weasels, are dangerous; and the folds, with the adjacent ground, should be free from mud, mire, dust, nettles, nightshade, and not too heathy. There should always be a large fold, or round, close beside that in which the sheep are to be sorted, into which the ewes and lambs, after being slowly gathered, should be put with as little fatigue as possible; and skilful and experienced persons should be appointed to catch the males and mark them on the ear, or some other conspicuous part, with tar, and all confusion and hurry avoided; for, as Mr. Laidlaw justly remarks, "in many instances improper management occasions more loss than the whole circle of diseases."—When the lambs are taken up to be cut, they should never be catched by the back or flanks, or any other part except the horns or neck: and if a lamb escapes, and has to be caught by dogs, it should be put into another fold, that it may cool leisurely before it be cut.

The operator should by all means abstain from spirituous liquors, and the operation itself ought to be performed as gently as possible, by slitting up the scrotum with a sharp smooth-edged knife, and starting the testacles, by pressing both hands against the belly of the lamb. In removing them, the chords should be taken between the fingers while the backs of the hands are kept steady against the belly of the lamb, and the stones drawn somewhat upwards, till they separate. Its hind legs are to be directly unloosed, and its tail two or three times hastily pulled, to replace the chord and vessels which have been drawn out. The top of the scrotum should never be cut away, nor too firm a hold taken of the testicles. In performing this operation, the rim of the belly *(peritoneum)* sometimes gives way, and the *omentum* or intestines follow; the latter should be immediately gently replaced; but the *omentum*, if it hang far down, may be cut away, and the wound is to be sewed up. After the operation, as much care as possible should be taken that the lambs do not get sand or dirt into the wound, or irritate it in any way. The fatter and stronger the lambs are when cut, the greater is the danger of loss from inflammation and mortification. When this is apprehended, some farmers anoint the cavity of the scrotum with a feather dipt in turpentine, which is a certain preventive of these effects, but it as certainly checks the growth of the lamb for eight or ten days, and when the folds are clean, the weather good, and the lambs gently used, it is better omitted. If there is to be great loss from the operation, it will be evident the second day. Some will even die the very day of the operation; but the greatest mortality is on the third and fourth, and if the deaths are very numerous they will continue to occur for six or seven days. The carcases of lambs which die in consequence of being cut are generally much spoiled. The belly, flanks, and inside

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of the thighs are absolutely putrid. After mortification begins nothing will check its progress.

The Rev. Mr. Singers mentions a curious fact, which deserves to be recorded. "Mr. W. Gibson, on his farms in Crawfordmuir, in Lanarkshire, sustained great loss one season in his wedder lambs, after being cut. To his astonishment, some of the ewe lambs sickened and died, with highly putrid symptoms. The disorder had risen into the form of a putrid fever, which became at last infectious."

But there are also various accidents to which lambs are exposed, such as drowning, falling into pits, and being destroyed by beasts and birds of prey. An experienced shepherd can easily determine if a lamb be lost in any of these ways. If it has fallen into a pit, the dam runs away in a frantic disordered state, utters a wild sort of cry, comes hastily back, and if she be allowed, will look into the hole or pit where it is: when destroyed by any beast or bird of prey, her behaviour is still more disordered, she runs about from one of her neighbours lambs to another's, and the tremor of her voice indicates the perturbation of her mind; sometimes she utters her woes in a long melancholy tone, at other times her bleat has a wild and inarticulate scream, expressive of her anguish. It requires the most skilful management to get a ewe, which has lost its lamb in this way, to adopt another, probably from having suffered in her attempts to defend it, which, notwithstanding the meekness of her spirit at other times, she does as long as she is able, especially when her lamb is young.

Weaning.—About the middle, or, if the preceding winter shall have been severe, about the end of July, the lambs must be weaned; for any little advantage which may be supposed to accrue to them from allowing them to suck their mothers longer, is much more than counterbalanced by the injury done to the ewes, as it renders them lean, subject to rot the following spring, and barren next season.

Weaning them is a matter of great difficulty and considerable delicacy, especially if their number be large and their pasture inconvenient, and requires all the skill and ingenuity of the most experienced shepherd. Every necessary precaution should be observed to prevent them from wasting themselves with running. In the business of folding, care must be taken that no material situation be intrusted to an unskilful person. After the lambs are lifted from their mothers, they should be allowed to pass that night in the neighbourhood of the fold. Most of this time is employed in gathering round, and looking into the fold, bleating incessantly. Next morning some of them begin to eat, others more impatient gather into crowds, arrange themselves for running, and try to escape away to that ground on which they had pastured with their mothers. They should now be removed to some easy, soft, grassy pasture; and in removing them by all means refrain from dogging them, which is sure of scattering and heating them; neither stop the point of the wedge into which they have arranged themselves, but if the situation of the ground permit, let them go in an uphill direction; and if they get time, and dogs and unskilful people are kept back, there is not much danger. There is, however, some hazard that they will not rest quietly the first night after they are removed from the fold. This, however, may be effectually prevented by pasturing them with their mothers, the night immediately preceding their weaning, on their future pasture, and driving them to the fold directly in that road by which the lambs are to be removed from it.

The ewes if they are not drawn will in ten or twelve days cease to have any milk; and if the lambs are now left at liberty, they will return to their former pasture, and associate ever afterwards with their mother.

To make it more plain, Mr. J. Hog desires the farmer to take the ewes of each distinct hill or ridge, and about the middle of July select from each of these a sufficient number of the best lambs to replace the aged, infirm, and barren of that certain department. Let him put a general mark on the mothers, to know them from his other ewes. Let him keep the lambs by themselves, or with the barren sheep, until the milk is gone from the mothers, then turn them at large; when each ewe will know her own lamb. Though generally dispersed among the other sheep, the mothers who should have their lambs again to follow them will be easily known, and the farmer should not fail to renew their acquaintance. Of the incalculable advantages resulting from this method of rearing lambs the country is indebted to Mr. William Bryden, senior, of Riskenhope, many years tenant of his grace the Duke of Buccleugh. It both keeps the hogs at home, and makes them acquainted with their own pasture, without hurting the mother by sucking her, and in a few years every little department of the farm becomes stocked with a distinct class of friends, who will never separate; for however thoroughly they may intermix with other sheep during the day, in the evening they separate voluntarily, and draw to their respective resting-places. It may not be improper here, as it affords a strong argument in favour of this system, to mention, that no animal is more attached to that spot of earth on which it spent the days of its youth than the sheep. "It is this principle," says Mr. W. Hog, "which actuates our draught ewes, in the very centre of England, and upon the richest pasture. One ewe made her escape from Yorkshire, and after coming through towns, crossing rivers, &c. at last revisited her native clime in the hills of Annandale. Another from Perthshire came back to Hundleshope, a store farm about twenty-three miles south of Edinburgh. When she came to Stirling it was fair-day, she durst not venture through the town among the populace, but rested herself at its north side, till the fair dispersed, and came through late in the evening. There is scarcely a season but parties or individuals are seen passing through our boundaries that we know not whence they come, nor whither they are going; and sometimes we recognise Highland ewes that have made their escape from English pastures, and are making the best of their way to the north."

"But the above method may not always be found to be convenient. Upon certain farms a great number of hogs are kept in proportion to the old sheep. Certain parts of these farms may be high, as is often the case, to which sheep can have no access for a great part of the year. Upon such high parts it is necessary to summer-grass the ewes. And that every possible benefit and advantage may be derived from such high places, it may be found necessary to stock them sufficiently with the old ewes; so that, if in such situations the lambs were confined with their mothers, both might be equally hurt.

"In such a case, the treatment of the lambs intended for hogs should be as follows. After weaning the lambs, I would recommend putting them for two weeks upon clean low land, and thereafter sending them out to a summer-hill by themselves. And in practising this mode, if the summer-hill is covered with much of what is called *bent grass*, the lambs should be sent out to it immediately on being weaned, or as soon as they will drive. The reason is, that this kind of grass is of very little use for pasture after the middle of August. But if the part of the farm intended for the lambs after being weaned is clothed with a mixture of heath and grass, or wholly either, there need not be so much dispatch in sending them to it."

"I am quite of a different opinion from many as to the mode of summering lambs. If, as circumstances permit, either of the above methods be observed in a proper and judicious way, instead of injuring the hogs, I think they may be bettered in many respects. For instance, if a farm is so situated that sheep cannot pasture upon two-thirds of it, perhaps from Martinmas till near the first of May, what is to be done for winter food? The generality of low country people have scarcely any idea of such a situation. The example of the bee must here be surely followed, laying up something in summer for winter store. By driving the old ewes to the high extremities of the farm, and summering the lambs upon good healthy pasture nearer home, the lower lands are reserved for winter food. The lambs in this manner learn the different marches; and they often eat up several plots of ground, where, from their local situation, the old sheep might not always be very easily confined. By summering lambs in this manner, I do not at all mean pinching them. I would have them always kept in a thriving state; which may be easily done, however high or coarse the land is, by giving them plenty of space to range upon, and by not keeping them too long upon one spot, but frequently shifting them from place to place."

Besides, by being thus accustomed to such coarse food in summer, they live better on it in winter, if it should prove severe, and they have nothing else to depend upon. They also acquire a greater hardiness of constitution than lambs that pasture in August and September on soft grassy lands, and they are said to be less liable to sickness. It certainly makes them eat their winter pasture more equally, which is generally allowed to be a preventive of sickness. They should therefore by no means be suffered to feed the whole day on those parts where the finest grass abounds, but should be kept from four to five in the evening till seven or eight next morning, on the high part of their ground, where there is plenty of coarse meat. From the end of September, or beginning of October, when the ground is completely drenched with rain, they may be allowed greater liberty.

By this method of treatment they are said to rise superior in wool, bone, and condition, to other lambs, and to acquire that uniformity in shape, size, and colour, which is necessary for the English market. It, however, subjects them to severe loss from sickness, which is almost entirely avoided, by allowing them to follow their mothers; and where no more lambs are kept, than what are necessary to replace deficiencies in the stock, this method should be always adopted. By associating with the old sheep, instead of lying all night without rising, and indulging next morning in rich food to excess, they benefit by the experience of their mothers, by which means they commonly leave their resting places about eleven at night, and feed till one or two in the morning. By not undergoing the fatigue inseparable from herding they are also more active, are better enabled to support the severities of the winter, are in better condition next spring, and in every respect thrive better the ensuing season.

Sickness *.—This is the most quickly fatal of all the diseases to which sheep are liable, for not unfrequently, out of a flock of 300 hogs, all of which the night before seemed in perfect health, six, seven, or more are found dead; some of them with their feet under them as they had lain down to rest. When its progress can be observed, the animal seems to become uneasy, ceases to feed, but, when it has an opportunity, drinks frequently. When narrowly inspected, its eyes are found to be half closed, dull, inflamed, and watery; the mouth, tongue, and skin, dry and parched; the pulse strong and frequent, and the breathing quick and difficult. It grinds its teeth, lies down and rises up repeatedly, or stands motionless, with its head hanging down, and its back erect, or creeps away from its comrades, with a slow and stiff motion, to the edge of some precipice, or overhanging rock, holm, or other retired spot, while it lies bleating, or rather screaming, from agony, its wool claps to the body, which swells sometimes to such a degree that the peritoneum, or rim of the belly, as it is called by the shepherds, gives way, and strong convulsions are succeeded by death in a few hours from the first attack. Some of them will live several days, but seldom a week, unless they recover, which is a rare occurrence. During this time there is seldom any passage through the bowels, the urine is scanty and high coloured, and the blood is absolutely black, and so thick, that when a vein is opened, scarcely a drop or too oozes from the orifice.

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* *Sickness.* Mr. Stevenson, Mr. W. Hog, Mr. Battie, Mr. Laidlaw, *Sickness* or *Braxy.* Rev. Mr. Singers, Mr. J. Hog, Mr. Scott. *Braxy.* Mr. Welsh, Mr. Campbell.

Appearances on Dissection.—On examining the body after death, almost every part of it exhibits appearances more or less strongly marked of inflammation and mortification, or a tendency to putrefaction. When the stomach, intestines, or other abdominal viscera are most affected, it is said to be in the read or bowels, and when the muscular parts, to be in the flesh or blood. Again, when in the first of these species, there is a remarkable effusion of bloody serum into the cavity of the belly, it has been called the *water-sickness.* From the dissections which have been made, there appear to be even more kinds of sickness than those named; and although the practical utility of such distinctions in a disease so speedily fatal, may not be immediately apparent, it is necessary to enumerate them, that at last, by observing particularly the other morbid changes with which they are sometimes or always accompanied, the symptoms which affected the animal when alive, and the circumstances which preceded the attack, we may obtain a perfect history of all the forms of this destructive disease.

A. *Varieties of Bowel Sickness.*—Sp. 1. Most commonly the stomach is its chief seat, constituting what nosologists term *gastritis.* In this variety the belly is prodigiously

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prodigiously swelled, the carcase is much discoloured, and a sour pituitous matter is diffused through the whole system, especially the fleshy parts. The fat appears least changed; but although it melts to grease it has always a bloody appearance, from which it cannot be cleared. On opening the body it emits a strong sulphureous smell, characteristic of the disease; hence it is sometimes called the *stinking ill*, and the stomach and bowels are prodigiously distended with air, having the same intolerable fœtor. 'A general redness pervades the whole bowels. The two first stomachs are rarely the particular seat of the disease, the third occasionally, but the fourth, and especially that part of it next the intestines, known amongst professional men by the name *pylorus*, is always much thickened, inflamed, or even mortified. The food found in the stomach, especially the third, is quite dry, and may be crumbled to powder between the fingers. The kidneys are completely mortified, and resemble a mass of putrid gore. The liver is also much affected. The heart and lungs only partake in some degree of the general redness.'

This is the most common kind of sickness, is peculiar to hogs on the first setting in of frost, is not to be distinguished during the life of the animal, but by the excessive swelling of the belly, and is almost always speedily fatal.

Sp, 2. The variety most nearly resembling that now described, is that, where instead of the stomach, the small guts are inflamed and mortified, constituting the disease called *enteritis*. In this the carcase is much less swelled, and not nearly so blue and putrid, except that the chewed grass in the maw is very stiff, and almost quite solid to feel; the stomach is scarcely affected in the least, but the small guts are mortified, black, soft, and almost quite rotten, the inflammation having obviously originated in one of the latter folds of these. "In one or two instances I observed a small fold or doubling in the intestines, which, by some wind passing through them, had forced its way through the thin texture that covers them, and by which the fat hangs. This was full of air, quite black and mortified, as were several of the folds above it." Indeed Mr. J. Hog plausibly enough conjectures, that this variety is caused by a twist or intus-susception of the intestines, produced by enlarged and hardened lumps of purl obstructing all passage through them.

It attacks only hogs, which have plenty of grass when the weather is mild, during storms of snow, when their walk is much circumscribed, and when they are confined to the tops of heather, bent, and other dry sapless food. It is not so speedily fatal as the former species, and they sometimes linger a day or two in great agony, without appearing much swelled.

Sp. 3. The seat of the disease is sometimes in the urinary bladder, constituting the *cystitis* of nosologists. The symptoms resemble those of the first species, and the putrid taint of the carcase is nearly the same.

TO BE CONTINUED IN OUR NEXT.

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Electro-Chemical Researches, on the Decomposition of the Earths; with Observations on the Metals obtained from the alkaline Earths, and on the Amalgam procured from Ammonia.

By HUMPHRY DAVY, *Esq. Sec. R. S. M. R. I. A.*

(Continued from Page 60.)

WHILST I was engaged in these experiments, in the beginning of June, I received a letter from Professor Berzelius of Stockholm, in which he informed me that in conjunction with Dr. Pontin, he had succeeded in decomposing barytes and lime, by negatively electrifying mercury in contact with them, and that in this way he had obtained amalgams of the metals of these earths.

I immediately repeated these operations with perfect success; a globule of mercury, electrified by the power of the battery of 500, weakly charged, was made to act upon a surface of slightly moistened barytes, fixed upon a plate of platina. The mercury gradually became less fluid, and after a few minutes was found covered with a white film of barytes: and when the amalgam was thrown into water, hydrogen was disengaged, the mercury remained free, and a solution of barytes was formed.

The result with lime, as these gentlemen had stated, was precisely analogous.

That the same happy methods must succeed with strontites and magnesia, it was not easy to doubt, and I quickly tried the experiment.

From strontites I obtained a very rapid result; but from magnesia, in the first trials, no amalgam could be procured. By continuing the process, however, for a longer time, and keeping the earth continually moist, at last a combination of the basis with mercury was obtained, which slowly produced magnesia by absorption of oxygen from air, or by the action of water.

All these amalgams I found might be preserved for a considerable period under naphtha. In a length of time, however, they became covered with a white crust under this fluid. When exposed to air, a very few minutes only were required for the oxygenation of the bases of the earths. In water the amalgam of barytes was most rapidly decomposed: that of strontites and that of lime next in order: but the amalgam from magnesia, as might be expected from the weak affinity of the earth for water, very slowly changed; when a little sulphuric acid was added to the water, however, the evolution of hydrogen, and the production and solution of magnesia were exceedingly rapid, and the mercury soon remained free.

I was inclined to believe, that one reason why magnesia was less easy to metallise than the other alkaline earths, was its insolubility in water, which would prevent it from being presented in the nascent state, detached from its solution at the negative surface. On this idea I tried the experiment, using moistened sulphate of magnesia instead of the pure earth, and I found that the amalgam was much sooner obtained. Here the magnesia was attracted from the sulphuric acid, and probably deoxygenated and combined with the quicksilver at the same instant.

The amalgams of the other bases of the alkaline earths could, I found, be obtained in the same manner from their saline compounds.

I tried in this way very successfully, muriate and sulphate of lime, the muriate of strontites, and of barytes, and

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and nitrate of barytes. The earths separated at the deoxygenating surface, there seemed instantly to undergo decomposition, and seized upon by the mercury, were in some measure defended from the action of air, and from the contact of water, and preserved by their strong attraction for this metal.

III. *Attempts to procure the Metals of the alkaline Earths; and on their Properties.*

To procure quantities of amalgams sufficient for distillation, I combined the methods I had before employed with those of MM. Berzelius and Pontin.

The earths were slightly moistened, and mixed with one-third of red oxyd of mercury, the mixture was placed on a plate of platina, a cavity was made in the upper part of it to receive a globule of mercury of from fifty to sixty grains in weight, the whole was covered by a film of naphtha, and the plate was made positive, and the mercury negative, by a proper communication with the battery of five hundred.

The amalgams obtained in this way, were distilled in tubes of plate glass, or in some cases in tubes of common glass. These tubes were bent in the middle, and the extremities were enlarged, and rendered globular by blowing, so as to serve the purposes of a retort and receiver.

The tube after the amalgam had been introduced, was filled with naphtha, which was afterwards expelled by boiling, through a small orifice in the end corresponding to the receiver, which was hermetically sealed when the tube contained nothing but the vapour of naphtha and the amalgam.

I found immediately that the mercury rose pure by distillation from the amalgam, and it was very easy to separate a part of it; but to obtain a complete decomposition was very difficult.

For this nearly a red heat was required, and at a red heat the bases of the earths instantly acted upon the glass, and became oxygenated. When the tube was large in proportion to the quantity of amalgam, the vapour of the naphtha furnished oxygen sufficient to destroy part of the bases: and when a small tube was employed, it was difficult to heat the part used as a retort sufficient to drive off the whole of the mercury from the basis, without raising too highly the temperature of the part serving for the receiver, so as to burst the tube *.

In consequence of these difficulties, in a multitude of trials, I obtained only a very few successful results, and in no case could I be absolutely certain that there was not a minute portion of mercury still in combination with the metals of the earths.

In the best result that I obtained from the distillation of the amalgam of barytes, the residuum appeared as a white metal of the colour of silver. It was fixed at all common temperatures, but became fluid at a heat below redness, and did not rise in vapour when heated to redness, in a tube of plate glass, but acted violently upon the glass, producing a black mass, which seemed to contain barytes, and a fixed alkaline basis, in the first degree of oxygenation †.

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* When the quantity of the amalgam was about fifty or sixty grains, I found that the tube could not be conveniently less than one-sixth of an inch in diameter, and of the capacity of about half a cubic inch.

† From this fact, compared with other facts that have been stated, p. 57, it may be conjectured, that the basis of barytes has a higher affinity for oxygen than sodium; and hence, probably the bases of the

When exposed to air it rapidly tarnished, and fell into a white powder, which was barytes. When this process was conducted in a small portion of air, the oxygen was found absorbed, and the nitrogen unaltered: when a portion of it was introduced into water, it acted upon it with great violence, and sunk to the bottom, producing in it barytes; and hydrogen was generated. The quantities in which I obtained it were too minute for me to be able to examine correctly, either its physical or che-

the earths will be more powerful instruments for detecting oxygen than the bases of the alkalies.

I have tried a number of experiments on the action of potassium on bodies supposed simple, and on the undecompounded acids. From the affinity of the metal for oxygen, and of the acid for the substance formed, I had entertained the greatest hopes of success. It would be inconsistent with the object of this paper to enter into a full detail of the methods of operation; I hope to be able to state them fully to the Society at a future time, when they shall be elucidated by farther researches. I shall now merely mention the general results, to shew that I have not been tardy in employing the means which were in my power, towards effecting these important objects.

When potassium was heated in muriatic acid gas, as dry as it could be obtained by common chemical means, there was a violent chemical action with ignition; and when the potassium was in sufficient quantity, the muriatic acid gas wholly disappeared, and from one-third to one-fourth of its volume of hydrogen was evolved, and muriate of potash was formed.

On fluoric acid gas, which had been in contact with glass, the potassium produced a similar effect; but the quantity of hydrogen generated was only one-sixth or one-seventh of the volume of gas, and a white mass was formed, which principally consisted of fluate of potash and silex, but which emitted fumes of fluoric acid when exposed to air.

When boracic acid, prepared in the usual manner, that had been ignited, was heated in a gold tube with potassium, a very minute quantity of gas only was liberated, which was hydrogen, mixed with nitrogen (the last probably from the common air in the tube); borate of potash was formed; and a black substance, which became white by exposure to air.

mical properties. It sunk rapidly in water, and even in sulphuric acid, though surrounded by globules of hydrogen, equal to two or three times its volume; from which it seems probable, that it cannot be less than four or five times as heavy as water. It flattened by pressure, but required a considerable force for this effect.

The metal from strontites sunk in sulphuric acid, and exhibited the same characters as that from barytes, except in producing strontites by oxydation.

The metal from lime I have never been able to examine exposed to air or under naphtha. In the case in which I was able to distil the quicksilver from it to the greatest extent, the tube unfortunately broke, whilst

In all these instances there is great reason to believe that the hydrogen was produced from the water adhering to the acids; and the different proportions of it in the different cases are a strong proof of this opinion. Admitting this idea, it seems that muriatic acid gas must contain at least one-eighth or one-tenth of its weight of water; and that the water oxygenates in the experiment a quantity of potassium, sufficient to absorb the whole of the acid.

In the cases of fluoric and boracic acids there is probably a decomposition of these bodies; the black substance produced from the boracic acid is similar to that which I had obtained from it by electricity. The quantities that I have operated upon have been as yet too small to enable me to separate and examine the products; and till this is done no ultimate conclusion can be drawn.

The action of potassium upon muriatic acid gas indicates a much larger quantity of water in this substance than the action of electricity in Dr. Henry's elaborate experiments; but in the one instance the acid enters into a solid salt, and in the other it remains aëriform; and the difficulty of decomposition by electricity must increase in proportion as the quantity of water diminishes, so that at the apparent maximum of electrical effect there is no reason to suppose the gas free from water.

Those persons who have supposed hydrogen to be the basis of muriatic acid may, perhaps, give another solution of the phenomena, and consider the experiment I have detailed as a proof of this opinion.

warm, and at the moment that the air entered, the metal, which had the colour and lustre of silver, instantly took fire, and burnt with an intense white light into quicklime.

The metal from magnesia seemed to act upon the glass, even before the whole of the quicksilver was distilled from it. In an experiment in which I stopped the process before the mercury was entirely driven off, it appeared as a solid, having the same whiteness and lustre as the other metals of the earths. It sunk rapidly in water, though surrounded by globules of gas, producing magnesia, and quickly changed in air, becoming covered with a white crust, and falling into a fine powder, which proved to be magnesia.

In several cases in which amalgams of the metals of the earths, containing only a small quantity of mercury were obtained, I exposed them to air on a delicate balance, and always found that during the conversion of metal into earth, there was a considerable increase of weight.

I endeavoured to ascertain the proportions of oxygen and bases in barytes and strontites, by heating amalgams of them in tubes filled with oxygen, but without success. I satisfied myself, however, that when the metals of the earths were burned in a small quantity of air they absorbed oxygen, gained weight in the process, and were in the highly caustic or unslacked state; for they produced strong heat by the contact of water, and did not effervesce during their solution in acids.

The evidence for the composition of the alkaline earths is then of the same kind as that for the composition of the common metallic oxyds; and the principles of their decomposition are precisely similar, the inflammable matters in all cases separating at the negative surface

face in the Voltaic circuit, and the oxygen at the positive surface.

These new substances will demand names; and on the same principles as I have named the bases of the fixed alkalies, potassium and sodium, I shall venture to denominate the metals from the alkaline earths barium, strontium, calcium, and magnium; the last of these words is undoubtedly objectionable, but magnesium* has been already applied to metallic manganese, and would consequently have been an equivocal term.

IV. *Enquiries relative to the Decomposition of Alumine, Silex, Zircone, and Glucine.*

I tried the methods of electrization and combination with quicksilver, and the common metals, by which I had succeeded in decomposing the alkaline earths, on alumine and silex; but without gaining distinct evidences of their having undergone any change in the processes.

Obliged to seek for other means of acting upon them, it was necessary to consider minutely their relations to other bodies, and to search for analogies by which the principles of research might be guided.

Alumine very slowly finds its point of rest at the negative pole, in the electrical circuit; but silex, even when diffused in its gelatinous state through water, rests indifferently at the negative or positive poles.

From this indifference to positive and negative electrical attractions, following the general order of facts, it might be inferred, that if these bodies be compounds, the electrical energies of their elements are nearly in equilibrium; and that their state is either analogous to that of insoluble neutral salts, or of oxyds nearly saturated with oxygen.

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* Bergman, Opusc. tom. ii. p. 200.

The combinations of silex and alumine, with acids and alkalies, as well as their electrical powers, were not inconsistent with either of these ideas; for in some respects they resemble in physical characters fluate and phosphate of lime, as much as in others they approach to the oxyds of zinc and tin.

On the idea that silex might be an insoluble neutro-saline compound, containing an unknown acid or earth, or both, and capable of being resolved into its secondary elements, in the same manner as sulphate of barytes, or fluate of lime, I made the following experiments.

Two gold cones*, connected by moistened amianthus, were filled with pure water, and placed in the electrical circuit; a small quantity of carefully prepared and well-washed silex was introduced into the positive cone: the action was kept up from a battery of two hundred plates for some hours, till nearly half of the fluid in each cone was exhausted; the remainders were examined; the fluid in the cone containing the silex was strongly acid; that in the opposite cone was strongly alkaline; the two fluids were passed through bibulous paper, and mixed together, when a precipitate fell down, which proved to be silex.

On the first view of the subject, it appeared probable that this silex had been formed by the union of the acid and the alkaline matter in the two cones, and that the experiment demonstrated a decomposition and recomposition of silex; but before such a conclusion could be made, many points were to be determined.

It was possible that the acid might be nitric acid, produced as in other electrical experiments of a similar nature, and that this acid might have dissolved silex, which was precipitated by the alkaline matter at the other pole, which might be either potash used for dissolving the silex which had adhered to it, notwithstanding the processes of lixiviation in acids, or ammonia produced im consequence of the presence of the atmosphere; or if potash was present, it was likewise possible that the silex might have been carried over in solution, with this alkali, from the positive to the negative surface.

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* The same as those described in Phil. Trans. 1807, p. 6.

Minute experiments were instituted and completed in the same manner as those detailed in the Philosophical Transactions for 1807, p. 7, which soon proved that there was no reason to suppose that the silex had been changed in these experiments.

The acid proved to be nitric acid, which under the electrical action seemed to have dissolved the silex; the alkali turned out to be principally fixed alkali; and that it was merely an accidental ingredient, and not a constituent of the silex, appeared from this circumstance, that when the same portion of silex was long electrified, by degrees it lost its power of affording the substance in question *.

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* If silex that has been carefully washed, after precipitation by muriatic acid from liquor silicum, be moistened, and acted on by mercury negatively electrified, the mercury soon contains a notable quantity of potassium. Well washed alumine that has been precipitated from alum by carbonate of soda, affords by the same treatment sodium and potassium, so that the powers of electro-chemical analysis are continually demonstrating the imperfection of the common chemical methods of separating bodies from each other. The purest boracic acid which can be obtained from borax by chemical decomposition, by electrical analysis is shewn to contain both soda and the decomposing acid employed in the process; and hence the experiment on the action of the boracic acid and potassium, p. 123, may possibly be explained without assuming its decomposition.

This result having taken place, the same plan of operation was not pursued with respect to alumine, which resembles a saline compound less than silex; and the method which I now adopted of acting upon these bodies, was on the supposition of their being inflammable substances so highly saturated with oxygen as to possess little or no positive electricity.

Alumine and silex have both a strong affinity for potash and soda; now supposing them to be oxyds, it was reasonable to conclude that the oxygen, both in the alkalies and the earths, must be passive as to this power, which must consequently be referred to their bases, and on this notion it was possible that it might be made to assist their decomposition by electricity.

After this reasoning, I fused a mixture of one part of silex and six of potash in a platina crucible, and preserved the mixture fluid, and in ignition, over a fire of charcoal; the crucible was rendered positive from the battery of five hundred, and a rod of platina, rendered negative, was brought in contact with the alkaline menstruum. At the moment of contact there was a most intense light; when the rod was plunged into the liquid an effervescence took place, and globules which burnt with a brilliant flame rose to the surface, and swam upon it in a state of combustion. In a few minutes, when the mixture was cool, the platina bar was removed: after as much as possible of the alkali and silex had been detached from it by a knife, there remained brilliant metallic scales round it, which instantly became covered with a white crust in the air, and some of which inflamed spontaneously. The platina appeared much corroded, and of a darker tint than belongs to the pure metal. When it was plunged into water it strongly effervesced: the fluid that came from it was alkaline; when a few drops of muriatic acid were added to the solution a white cloudiness occurred, which various trials demonstrated, depended upon the presence of silex.

A similar mixture of potash and alumine was experimented upon in the same manner, and the results were perfectly analogous; there adhered to the rod of platina a film of a metallic substance, which rapidly decomposed water, and afforded a solution which deposited alumine by the action of an acid.

I tried several forms of this experiment, with the hopes of being able to obtain a sufficient quantity of the metallic matter from the platina, so as to examine it in a separate state; but I was not successful. It was always in superficial scales, which oxydated, becoming white and alkaline, before it could be detached in the air; it instantly burnt when heated, and could not be fused under naphtha or oil.

I tried similar experiments with mixtures of soda and alumine, and soda and zircone, and used iron as the negatively electrified metal. In all these cases, during the whole process of electrization, abundance of globules, which swam in a state of inflammation on the fused mass, were produced. And in the mixture, when cooled, small laminæ of metal were found of the colour of lead, and less fusible than sodium, which adhered to the iron; they acted violently upon water, and produced soda and a white powder, but in quantities too small to be minutely examined.

I endeavoured to procure an alloy of potassium, and bases of the earths, from mixtures of potash, silex, and alumine, fused by electricity, and acted on by the positive and negative surfaces in the same manner as pure potash, in experiments for the decomposition of that substance; but I obtained no good results. When the earths were in quantities equal to one-fourth or one-fifth of the alkali, they rendered it so highly non-conducting that it was not easy to affect it by electricity, and when they were in very minute portions, the substance produced had the characters of pure potassium.

I heated small globules of potassium, in contact with silex and alumine, in tubes of plate glass filled with the vapour of naphtha: the potassium seemed to act at the same time upon the glass and the earths, and a greyish opaque mass, not possessed of metallic splendour, was obtained, which effervesced in water, depositing white clouds. Here it was possible that the potash had been converted wholly or partly into protoxyd, by its action upon the earths; but as no globule was obtained, and as the plate glass alone might have produced the effect, no decided inference of the decomposition of the earths can be drawn from the process.

I shall now mention the last trials that I made, with respect to this object.

Potassium, amalgamated with about one-third of mercury, was electrified negatively under naphtha, in contact with silex very slightly moistened, by the power of five hundred; after an hour the result was examined. The potassium was made to decompose water, and the alkali formed neutralized by acetous acid; a white matter, having all the appearance of silex, precipitated, but in quantity too small for accurate examination.

I tried the same method of action upon alumine and glucine, and obtained a cloudiness, more distinct than in the case of silex, by the action of an acid upon the solution obtained from the amalgam.

Zircone,

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Zircone, exposed in the same manner to the action of electricity and the attraction of potassium, furnished still more satisfactory results; for a white and fine powder, soluble in sulphuric acid, and which was precipitated from sulphuric acid by ammonia, separated from the amalgam that had been obtained, by the action of water.

From the general tenor of these results, and the comparison between the different series of experiments, there seems very great reason to conclude that alumine, zircone, glucine, and silex are, like the alkaline earths, metallic oxyds, for on no other supposition is it easy to explain the phenomena that have been detailed.

The evidences of decomposition and composition are not, however, of the same strict nature as those that belong to the fixed alkalies and alkaline earths; for it is possible, that in the experiments in which the silex, alumine, and zircone appeared to separate during the oxydation of potassium and sodium, their bases might not actually have been in combination with them, but the earths themselves in union with the metals of the alkalies, or in mere mechanical mixture. And out of an immense number of experiments which I made of the kind last detailed, a very few only gave distinct indications of the production of any earthy matter; and in cases when earthy matter did appear, the quantity was such as rendered it impossible to decide on the species.

Had I been so fortunate as to have obtained more certain evidences on this subject, and to have procured the metallic substances I was in search of, I should have proposed for them the names of silicium, alumium, zirconium, and glucium.

TO BE CONCLUDED IN OUR NEXT.

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Hydraulic Investigations, subservient to an intended Croonian Lecture on the Motion of the Blood.

By THOMAS YOUNG, *M. D. For. Sec. R. S.*

(Concluded from Page 54.)

III. *Of the Propagation of an Impulse through an elastic Tube.*

THE same reasoning, that is employed for determining the velocity of an impulse transmitted through an elastic solid or fluid body, is also applicable to the case of an incompressible fluid contained in an elastic pipe; the magnitude of the modulus being properly determined, according to the excess of pressure which any additional tension of the pipe is capable of producing; its height being such as to produce a tension, which is to any small increase of tension produced by the approach of two sections of the fluid in the pipe, as their distance to its decrement: for in this case the forces concerned are precisely similar to those which are employed in the transmission of an impulse through a column of air enclosed in a tube, or through an elastic solid. If the nature of the pipe be such, that its elastic force varies as the excess of its circumference or diameter above the natural extent, which is nearly the usual constitution of elastic bodies, it may be shewn that there is a certain finite height which will cause an infinite extension, and that the height of the modulus of elasticity for each point is equal to half its height above the base of this imaginary column, which may therefore be called with propriety the modular column of the pipe; consequently the velocity of an impulse will be at every point equal to half of that which is due to the height of the point above the base; and the velocity of an impulse ascending through the pipe being every where half as great as that of a body falling through the corresponding point in the modular column, the whole time of ascent will be precisely twice as great as that of the descent of the falling body; and in the same manner, if the pipe be inclined, the motion of the impulse may be compared with that of a body descending or ascending freely along an inclined plane.

These propositions may be thus demonstrated: let a be the diameter of the pipe in its most natural state, and let this diameter be increased to b by the pressure of the column c, the tube being so constituted that the tension may vary as the force. Then the relative force of the column c is represented by $b\,c$, since its efficacy increases, according to the laws of hydrostatics, in the ratio of the diameter of the tube; and this force must be equal, in a state of equilibrium, to the tension arising from the change from a to b, that is, to $b - a$; consequently the height c varies as $\frac{b-a}{b}$; and if the tube be enlarged to any diameter x, the corresponding pressure required to distend it will be expressed by a height of the column equal to $\left(1 - \frac{a}{x}\right) . \frac{b\,c}{b-a}$, since $\frac{b-a}{b} : c :: \frac{x-a}{x} : \left(1 - \frac{a}{x}\right) \frac{b\,c}{b-a}$. Now if the diameter be enlarged in such a degree, that the length of a certain portion of its contents may be contracted in the ratio $1 : 1 - r$, r being very small, then the enlargement will be in the ratio $1 : 1 + \frac{r}{2}$, that is, x' will be $\frac{rx}{2}$; but the increment of the force, or of the height is $\frac{ax'}{xx} \cdot \frac{bc}{b-a}$, which will become $\frac{ar}{2x} . \frac{bc}{b-a}$. Now in a tube filled with an elastic fluid, the height being h, the force in similar circumstances would be rh, and if we make $h = \frac{a}{2x} \cdot \frac{bc}{b-a}$, the velocity of the propagation of an impulse will be the same in both cases, and will be equal to the velocity of a body which has fallen through the height $\frac{1}{2} h$. Supposing x infinite, the height capable of producing the necessary pressure becomes $\frac{bc}{b-a}$, which may be called g, and for every other value of x this height is $\left(1 - \frac{a}{x}\right) g$, or $g - \frac{ag}{x}$, or since h becomes $\frac{ag}{2x}$, $g - 2h$, so that h is always equal to half the difference between g and the actual height of the column above the given point, or to half the height of the point above the base of the column.

If two values of x, with their corresponding heights, are given, as b and x, corresponding to c and d, and it is required to find a; we have $\frac{b-a}{b} : c :: \frac{x-a}{x} : d$, $dbx - dax = cbx - cba$, and $a = \frac{dbx - cbx}{dx - cb}$, or $\frac{b}{a} = \frac{dx - cb}{dx - cx}$. Thus if the height equivalent to the tension vary in the ratio of any power m of the diameter, so that, n being a small quantity, $x = b\ (1 + n)$ and $d = c\ (1 + mn)$, $\frac{b}{a} = \frac{bc\,((1+n).\,(1+mn) - 1)}{bc\,((1+n).\,(1+mn) - (1+n))} = \frac{mn + n}{mn}$, since the square of n is evanescent, and $\frac{b}{a} = \frac{m+1}{m}$. For example, if $m = 4$, $\frac{b}{a} = \frac{5}{4}$, and if $m = 2$, $b : a :: 3 : 2$.

IV. *Of the Magnitude of a diverging Pulsation at different Points.*

The demonstrations of Euler, Lagrange, and Bernoulli, respecting the propagation of sound, have determined that the velocity of the actual motion of the individual particles of an elastic fluid, when an impulse is transmitted through a conical pipe, or diverges spherically from a centre, varies in the simple inverse ratio of

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the distance from the vertex or centre, or in the inverse subduplicate ratio of the number of particles affected, as might naturally be inferred from the general law of the preservation of the ascending force or impetus, in all cases of the communication of motion between elastic bodies, or the particles of fluids of any kind. There is also another way of considering the subject, by which a similar conclusion may be formed respecting waves diverging from or converging to a centre. Suppose a straight wave to be reflected backwards and forwards in succession, by two vertical surfaces, perpendicular to the direction of its motion; it is evident that in this and every other case of such reflections, the pressure against the opposite surfaces must be equal, otherwise the centre of inertia of the whole system of bodies concerned would be displaced by their mutual actions, which is contrary to the general laws of the properties of the centre of inertia. Now if, instead of one of the surfaces, we substitute two others, converging in a very acute angle, the wave will be elevated higher and higher as it approaches the angle: and if its height be supposed to be every where in the inverse subduplicate ratio of the distance of the converging surfaces, the magnitude of the pressure, reduced to the direction of the motion, will be precisely equal to that of the pressure on the single opposite surface, which will not happen if the elevation vary inversely in the simple ratio of the distance, or in that of any other power than its square root. This mode of considering the subject affords us therefore an additional reason for asserting, that in all transmissions of impulses through elastic bodies, or through gravitating fluids, the intensity of the impulse varies inversely in the subduplicate

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ratio of the extent of the parts affected at the same time; and the same reasoning may without doubt be applied to the case of an elastic tube.

There is however a very singular exception, in the case of waves crossing each other, to the general law of the preservation of ascending force, which appears to be almost sufficient to set aside the universal application of this law to the motions of fluids. It is confessedly demonstrable that each of two waves, crossing each other in any direction, will preserve its motion and its elevation with respect to the surface of the fluid affected by the other wave, in the same manner as if that surface were plane: and, when the waves cross each other nearly in the same direction, both the height and the actual velocity of the particles being doubled, it is obvious that the ascending force or impetus is also doubled, since the bulk of the matter concerned is only halved, while the square of the velocity is quadrupled; and supposing the double wave to be stopped by an obstacle, its magnitude, at the moment of the greatest elevation, will be twice as great as that of a single wave in similar circumstances, and the height, as well as the quantity of matter, will be doubled, so that either the actual or the potential height of the centre of gravity of the fluid seems to be essentially altered whenever such an interference of waves takes place. This difficulty deserves the attentive consideration of those who shall attempt to investigate either the most refined parts of hydraulics, or the metaphysical principles of the laws of motion.

V. *Of the Effect of a Contraction advancing through a Canal.*

If we suppose the end of a rectangular horizontal canal, partly filled with water, to advance with a given velocity, less than that with which a wave naturally moves on the surface of the water, it may be shewn that a certain portion of the water will be carried forwards, with a surface nearly horizontal, and that the extent of this portion will be determined, very nearly, by the difference of the spaces described, in any given time, by a wave, moving on the surface thus elevated, and by the moveable end of the canal. The form of the anterior termination of this elevated portion, or wave, may vary, according to the degrees by which the motion may be supposed to have commenced; but whatever this form may be, it will cause an accelerative force, which is sufficient to impart successively to the portions of the fluid, along which it passes, a velocity equal to that of the moveable end, so that the elevated surface of the parts in motion may remain nearly horizontal: and this proposition will be the more accurately true the smaller the velocity of the moveable end may be. For, calling this velocity v, the original depth a, the increased depth x, and the velocity of the anterior part of the wave y, we have, on the supposition that the extent of the wave is already become considerable, $x = \frac{ay}{y \mp v}$, taking the negative or positive sign according to the direction of the motion of the end; since the quantity of fluid, which before occupied a length expressed by y, now occupies the length $y \mp v$; and putting $a \backsim x = z$, $z = \frac{av}{y \mp v}$. The direction of the surface of the margin of the wave is indifferent to the calculation, and it is most convenient to suppose its inclination equal to half a right angle, so that the accelerating force, acting on any thin transverse vertical lamina, may be equal to its weight: then the velocity y must be such, that while the inclined margin of the wave passes by each lamina, the lamina may acquire the velocity v, by a force equal to its own weight; consequently the time of its passage must be equal to that in which a body acquires the velocity v, in falling through a height b, corresponding to that velocity: and this time is expressed by $\frac{2b}{v}$; but the space described by the margin of the wave is not exactly z, because the lamina in question has moved horizontally during its acceleration, through a space which must be equal to b; the distance actually described will therefore be $z \pm b$, and we have $\frac{z \pm b}{y} = \frac{2b}{v}$, $z \pm b = \frac{2by}{v}$, $av \pm by - bv \doteq \frac{2byy}{v} \mp 2by$, $y^2 \mp \frac{3}{2} vy = \frac{av^2}{2b} - \frac{v^2}{v}$, $(y \mp \frac{3}{4} v)^2 = \frac{av^2}{2b} + \frac{v^2}{16}$; but, m being the proper coefficient, $v = m \surd b$, and $v^2 = m^2 b$, $\frac{av^2}{2b} + \frac{v^2}{16} = m^2 \left(\frac{a}{2} + \frac{b}{16}\right)$, $y \doteq m \surd \left(\frac{a}{2} + \frac{b}{16}\right) \pm \frac{3}{4} v$, and $y \mp v = m \surd \left(\frac{a}{2} + \frac{b}{16}\right) \mp \frac{1}{4} v$. But when v is small, we may take $y \mp v$ nearly $m \surd \frac{a}{2}$, and $z \doteq \frac{ma \surd b}{m \surd (\frac{1}{2} a)} = \surd (2ab)$, and $x = a \pm \surd (2ab)$, while the height of a fluid, in which the velocity would be y, is nearly $a \pm \frac{3}{2} \surd (2ab)$: consequently, when the velocity v is at all considerable, y must be somewhat greater than the velocity of a wave moving on the surface of the elevated fluid; and probably the surface of the elevated portion will not in this case be perfectly horizontal; but where v is small, y may be taken, without material error, $m \surd \frac{x}{2}$, or even $m \surd \frac{a}{2}$, which is the velocity of every small wave. The coefficient m is here assumed the same for the motion of a wave, as for the discharge through an aperture; and I have reason from observation to think this estimation sufficiently correct.

Supposing now the moveable end of the canal to remain open at the lower part as far as the height c, then the excess of a pressure, occasioned by the elevation before it, and the depression behind, will cause the fluid, immediately below the moveable plane, to flow backwards, with the velocity determined by the height, which is the difference between the levels; and the quantity thus flowing back, together with that which is contained in the moveable elevation, must be equal to the whole quantity displaced. But the depression behind the moveable body must vary according to the circumstances of the canal, whether it be supposed to end abruptly at the part from which the motion begins, or to be continued backwards without limit: in the first case, the elevation z will be to the depression as v to $y-v$, the length of the same portion of the fluid being varied inversely in that ratio; in the second case, the proportion will be as $y+v$ to $y-v$: and the difference of the levels will be $z+z\frac{y-v}{v}=\frac{zy}{v}$, or, secondly, $z+z\frac{y-v}{y+v}=\frac{2zy}{y+v}$; and first, $m\surd\frac{zy}{v}c+(y-v)z=(a-c)v$; but, since y is here considered as equal to $m\surd\frac{a}{T}$, putting $\surd\frac{a}{2}-\surd b=d$, $y-v=md$, and, calling $a-c$, e, $m\surd\frac{zy}{v}$, $c+mdz=me\surd b$, $\surd\frac{zy}{v}c+dz=e\surd b$, $c^2\frac{zy}{v}=e^2b+d^2z^2-2dze\surd b$, $z^2-\left(\frac{c2y}{a^2v}+\frac{2e\surd b}{d}\right)z=-\frac{e^2b}{d^2}$, and, calling $\frac{c^2y}{2d^2v}+\frac{e\surd b}{d}$, f, $z=f-\surd\left(f^2-\frac{e^2b}{d^2}\right)$: and in the same manner f is found, for the second case, equal to $\frac{c^2y}{d^2(y+v)}+\frac{e\surd b}{d}$. For example, suppose the height a 2 feet, $b=\frac{1}{4}$, $c=.1$, and consequently $e=1$, then d becomes $\frac{1}{2}$, $v=4$, and $y=8$; and in the first case $z=.1$, and in the second $z=.14$.

If

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If v, the velocity of the obstacle, were great in comparison with $m\sqrt{\frac{a}{2}}$, the velocity of a wave, and the space c below the obstacle were small, the anterior part of the elevation would advance with a velocity considerably greater than the natural velocity of the wave: but if the space below the obstacle bore a considerable proportion to the whole height, the elevation z would be very small, since a moderate pressure would cause the fluid to flow back, with a sufficient velocity, to exhaust the greatest part of the accumulation, which would otherwise take place. Hence the elevation must always be less than that which is determined by the equation $m\sqrt{zc} = ev$, and z is at most equal to $\left(\frac{ev}{mc}\right)^2 = \frac{e^2}{c^2}b$; but since the velocity of the anterior margin of the wave can never materially exeeed $m\sqrt{\frac{x}{2}}$, especially when z is small, and $\sqrt{\frac{x}{2}}$ being in this case nearly $\sqrt{\frac{a}{2}} + \frac{e^2}{2\sqrt{(\frac{1}{2}a)}\,c^2}b$, $m\sqrt{\frac{x}{2}} - m\sqrt{b} = m\left(\sqrt{\frac{a}{2}} + \frac{e^2 b}{\sqrt{(2a)}c^2} - \sqrt{b}\right)$ which, multiplied by z, shews the utmost quantity of the fluid that can be supposed to be carried before the obstacle. Supposing $b = \frac{1}{2}a$, this quantity becomes $m\sqrt{\frac{a}{2}} \cdot \frac{e^4}{c^4} \cdot \frac{a}{4}$; and if $\frac{e}{c}$ be, for example, $\frac{1}{10}$, it will be expressed by $\frac{1}{40000}av$, while the whole quantity of the fluid left behind.

A similar mode of reasoning may be applied to other cases of the propagation of impulses, in particular to that of a contraction moving along an elastic pipe. In this case, an increase of the diameter does not increase the velocity of the transmission of an impulse; and when the velocity of the contraction approaches to the natural velocity of an impulse, the quantity of fluid protruded must, if possible, be still smaller than in an open

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open canal; that is, it must be absolutely inconsiderable, unless the contraction be very great in comparison with the diameter of the pipe, even if its extent be such as to occasion a friction which may materially impede the retrograde motion of the fluid. The application of this theory to the motion of the blood in the arteries is very obvious, and I shall enlarge more on the subject when I have the honour of laying before the Society the Croonian Lecture for the present year.

The resistance, opposed to the motion of a floating body, might in some cases be calculated in a similar manner: but the principal part of this resistance appears to be usually derived from a cause which is here neglected; that is, the force required to produce the ascending, descending, or lateral motions of the particles, which are turned aside to make way for the moving body; while in this calculation their direct and retrograde motions only are considered.

The same mode of considering the motion of a vertical lamina may also be employed for determining the velocity of a wave of finite magnitude. Let the depth of the fluid be a, and suppose the section of the wave to be an isosceles triangle, of which the height is b, and half the breadth c: then the force urging any thin vertical lamina in a horizontal direction will be to its weight as b to c; and the space d, through which it moves horizontally, while half the waves passes it, will be such that $(c - d) . (a + \frac{1}{2} b) = ac$, when $c\ e\ d = \frac{bc}{2a+b}$. But the final velocity in this space is the same as is due to a height equal to the space, reduced in the ratio of the force to the weight, that is, to the height $\frac{bb}{2a+b}$, and half this velocity is $\frac{1}{2} m \surd \left(\frac{bb}{2a+b}\right)$, which is the mean velocity of the lamina. In the mean time the wave describes the space $c + d$, and its velocity is greater than that of the lamina in the ratio of $\frac{c}{d} + 1$ to 1, that is $\frac{2a+b}{b} + 1$ or $\frac{2a}{b} + 2$ to 1, becoming $m \left(\frac{a}{b} + 1\right) \frac{b}{\sqrt{(2a+b)}} = m \frac{a+b}{\sqrt{(2a+b)}}$; which, when b vanishes, becomes $m \sqrt{\frac{a}{2}}$, as in Lagrange's theorem, and when b is small, $m \left(\sqrt{\frac{a}{2}} + \frac{3}{4} \frac{b}{\sqrt{(2a+b)}}\right)$, or $m \frac{a + \frac{3}{4} b}{\sqrt{(2a)}}$; but if a were small, it would approach to $m \sqrt{b}$, the velocity due to the whole height of the wave.

List of Patents for Inventions, &c.

(Continued from Page 72.)

Samuel Crackles, of the town and county of the town of Kingston-upon-Hull, Brush-manufacturer; for a method of making and manufacturing of brushes from whalebone, which have heretofore been usually made and manufactured from bristles. Dated November 3, 1808. Specification to be enrolled within one month.

Samuel Brookes, of Bermondsey, in the county of Surrey, Tanner; for splitting raw, bull, ox, and cow hides, so that each side of the hide so split may be manufactured for the purposes for which an entire hide has been before used, as follows: the grain-side for coach and chaise hides, and other purposes; and the flesh-side for losh hides, for white leather, for vellum, for tanning, and for other purposes. Dated November 3, 1808. Specification to be enrolled within four months.

John Hartley, John Musgrave, and **William Farmery**, of Leeds, in the county of York, Machine-makers; for a machine for the purpose of preparing, roving, slubbing, spinning, twisting, and doubling of cotton, flax, hemp, tow, worsted, wool, silk, or any other substance, into threads, preparatory to their being manufactured, or otherwise used. Dated November 8, 1808. Specification to be enrolled within six months.

Nicholas Fairles, of South Shields, in the county of Durham, Esquire; for a windlass, windlass bitts, and metallic hawse-hole chamber, whereby great manual labour is saved, and a considerable less space of time is necessary in heaving to, and getting on-board ship's anchors either in moderate weather or in gales of wind. Dated November 15, 1808. Specification to be enrolled within four months.

Jonathan Dickson, of the parish of Christ Church and county of Surrey, Steam Engine-maker; for improvements in the construction of tuns, coolers, vatts, and backs used by brewers, distillers, and others. Dated November 15, 1808. Specification to be enrolled within one month.

Charles Gostling Townley, of Ramsgate, in the county of Kent, Esquire; for an improvement applicable to musical instruments of different descriptions. Dated November 26, 1808. Specification to be enrolled within one month.

Frederick Nolan, of Stratford, near Colchester, in the county of Essex, Clerk; for certain improvements in the construction of flutes, flagelets, hautbois, and other wind instruments now in use. Dated November 26, 1808. Specification to be enrolled within four months.

Charles Seward, of Lancaster, in the county of Lancaster, Block Tin-manufacturer; for some improvements in the construction of lamps. Dated November 26, 1808. Specification to be enrolled within one month.

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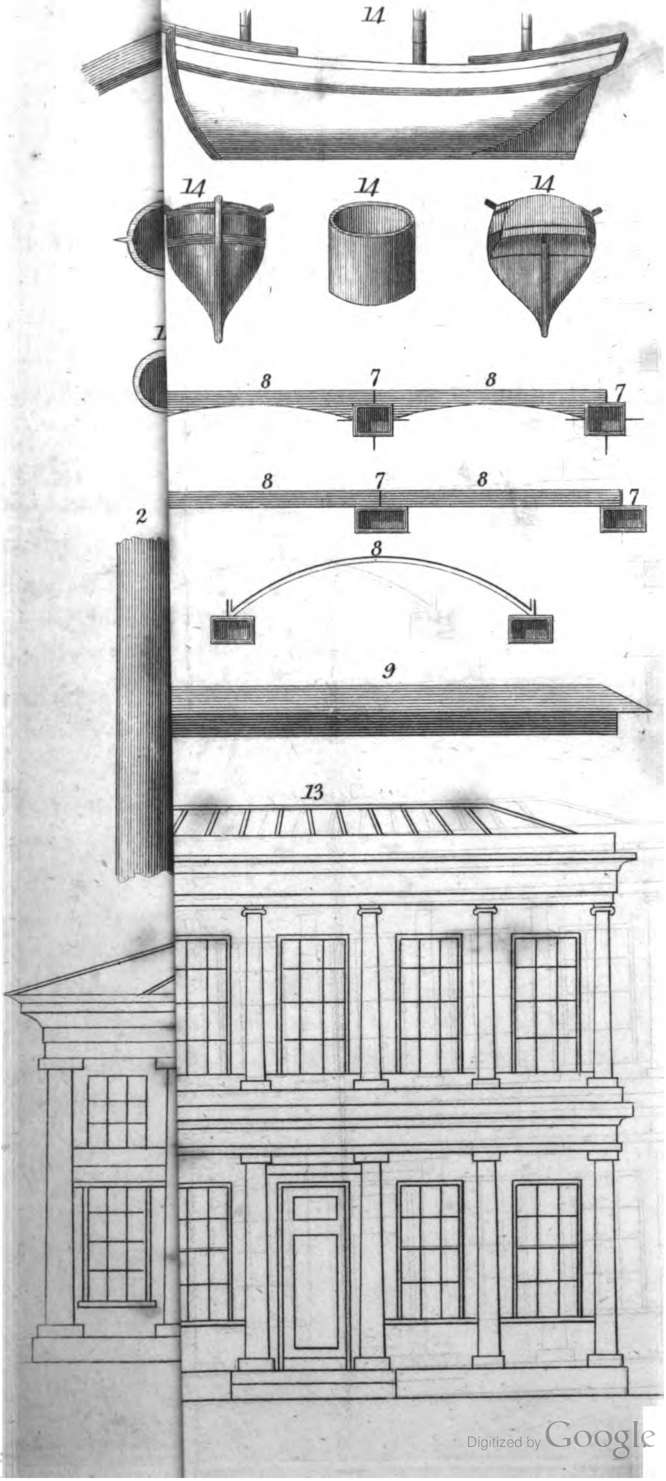

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THE

REPERTORY

OF

ARTS, MANUFACTURES,

AND

AGRICULTURE.

No. LXXXI. SECOND SERIES. Feb. 1809.

Specification of the Patent granted to Ralph Dodd, *of Change Alley, in the City of London, Engineer; for improved Bridge Floorings or Platforms, and fire-proof Floorings and Roofings, for extensive dwelling Houses, Warehouses, and Mills.* Dated June 3, 1808.

With a Plate.

To all to whom these presents shall come, &c. Now know ye, that in compliance with the said proviso, I the said Ralph Dodd do hereby declare that my said invention is described in manner following; that is to say: A certain mode and method of applying malleable iron and other metals, and condensed earth or artificial stone, and described in such like figures and shape as hereunto annexed.

Fig. 1 (Plate V.) a tubical rib, either to be used empty or filled, or part filled with condensed earth or artificial stone, or to be coated outside with the same, to be made of any figure, from the circle to the square, and to be applied from one pier to another, or bearings, either straight, eliptical, triangular, or forming a segment or circle.

Fig. 2 an upright shaft or column for sustaining heavy weight, strengthened internally or externally with condensed earth or artificial stone, is either fitted wholly or in part.

Fig. 3 ditto, with flanges or joints, for attaching one to each other, to stand upright or to be laid horizontal, for bearing heavy pressures, or conducting fluids or air, in a cold or heated state, through them, when part of the centre is left void of condensed earth or artificial stone; for that purpose the outside may be coated with the same or not, at the pleasure of the user.

Fig. 4 a square tube, to be coated internally or externally with condensed earth or artificial stone, to be used for the purposes as described in Fig. 3, or with or without coating, to be used as a beam, rafter, joice, girder, pile, or upright standard or stancheon, in any depth or breadth.

Fig. 5 the same as described in Fig. 4, with the additional ears or flanges marked *a b*, with *c d*, pieces of timber fastened to the same for nailing on laths, nailing or screwing down flooring, or making other necessary fastenings.

Fig. 6 the same as Fig. 5, with the centre ears or flanges, to be used either perpendicular or horizontal; when the latter, to be used with attached iron or other metal plates or materials, or receiving of them in horizontal segments or eliptical forms.

Fig. 7 the same as Fig. 6, with four or more ears or flanges attached for purposes described in Fig. 6, when connecting with a segment, eliptical or straight plate, covered or uncovered with condensed earth or artificial stone from each other, as Figs. 8, 8, 8, by which means attached floorings above them are rendered fire-proof, and an effectual covering for houses instead of tiling or slating.

Fig. 9 a tubical beam, made of materials before described, with two upper ears or flanges to fasten down platforms, decks, and floorings, or other attached parts, to be formed of any figure, from the square to the segment, taper, twisting, or anglewise; made water-tight, to prevent their sinking.

Fig. 10 an upright shaft or column, as described in Figs. 2 and 3, in the two projecting ears or flanges, on each side, for attaching to any fixture.

Fig. 11 the same as Fig. 10, when made without ears, and used as masts, standards, yards, or booms.

Fig. 12 a square tube, with centre upper and under ears or flanges, to be used as in Figs. 6 and 7.

Figs. 13, 13, 13, the various parts when combined in the formation of houses, warehouses, or mills, coated or not, internally or externally, with condensed earth or artificial stone.

Figs. 14, 14, 14, 14. The various parts when combined apply to vessels floating in or on water, or to contain any fluid, coated or not, internally or externally, with condensed earth or artificial stone.

In witness whereof, &c.

Specification of the Patent granted to CHARLES SEWARD, *of Lancaster, in the County of Lancaster, Block-Tin-manufacturer; for Improvements in the Construction of Lamps.* Dated November 3, 1808.

With an Engraving.

TO all to whom these presents shall come, &c. NOW KNOW YE, that in compliance with the said proviso, I the said Charles Seward do hereby declare that my said invention is described in manner following; that is to say: I shall first give a full and complete description of what I term my improved lamp, and then point out those improvements which I call my own; observing that I would claim a patent for each of these improvements separately, as well as for the improved lamp itself. This combination of improvements in the construction of lamps may remain the same, and yet the form of the lamps be infinitely varied. The following is a description of the most useful and common form of these lamps.

Description of the Lamp.

A, Fig. 1, (Plate VI.) is the lamp or reservoir of the oil; the shape of which is immaterial, so that it be made very shallow, or at least as shallow as it conveniently may, in order that the oil be always near the flame, and have as little as possible to ascend up the wick. It is also of some importance, that the body of the lamp be made no larger than to contain a sufficient quantity of oil for each time of burning. *b b* is the flat tube, to contain the wick. This tube is made so long as to reach quite to the bottom of the lamp; and, in order to give room to the wick, a little of one side of the wick-tube is cut away, or doubled up at the bottom, as at *c*, Fig. 1, which is a section of the lamp, but represents the wick-tube entire. The advantages attending this construction of the tube are, that the oil is warmed and kept from coagulating, especially that part of it which immediately surrounds the wick, and is in contact with the tube, which, in consequence of its conducting power, soon became warm throughout its whole length. Also the wick in a tube of this construction is not liable to slide down and extinguish the light, a defect frequently met with in lamps having tubes of the common construction. The wick-tube is soldered, or otherwise fixed, into a small round plate of tin, brass, or other suitable metal, the edge of which rests upon a shoulder on the inside of the brass screw *d d*. The plate and tube are held in their situation by means of a male screw *e e*, as in Miles's lamps.

Fig. 2 represents the above plate, in which *b* is the tube, and *f* a small hole for the admission of air. B is the chimney or lamp-glass; the shape of it is distinctly seen in the figure, and therefore requires no description. It is placed about a quarter of an inch above the top of the wick-tube, leaving a space from the bottom of the chimney to the top of the brass screw of about half an inch for the admission of air, instead of having air tubes as in Argand's lamps. But the proper height of the glass chimney above the lamp must be determined by experiment, for it varies with the size of the wick-tube and the size and even the form of the lamp. The chimney's support consists of a pretty strong wire *g g*, the lower end of which is soldered, or otherwise firmly fixed into the body of the lamp at *h*, and to the other end at *b* is soldered, or otherwise fastened, a hoop of tin, or any other metal capable of springing or opening, so as to embrace the lamp-glass. The lower end of the chimney rests upon a support *k*, firmly and immoveably fixed to the wire *g g*. In order to keep the lamp-glass steady, this support should at least be a quarter of an inch wide: the edge of it is only seen in the figure. These chimnies are not liable to be broken by the heat of the flame; they are also much stronger than cylindrical glasses, and have a handsome appearance, especially when the globular part is ground or roughened.

Directions for trimming and using the Lamp.

Unscrew the top, and charge the tube with a piece of wick, leaving nearly a quarter of an inch of the wick above, and about one inch below the tube. The higher the wick is the better, so that the lamp does not smoke. It is proper to observe, in regard to those lamps with chimnies, that they are more liable to smoke immediately after placing the chimney than when it has been on a few minutes and got heated by the flame. The wick is easily introduced into the tube by means of a strip of tin, which is sent with the lamp. Having charged the tube, replace it in the lamp, taking care to put the end of the wick so that it may lay at the bottom of the lamp, on that side of the tube which is cut away, in order to make room for it.

Having filled the lamp, screw the top tight down, to prevent the oil from spilling. The proper oils for these, and all other lamps, are those which are clear, and of a pale colour. The dark-coloured oils generally contain a considerable quantity of impure matter, which, not being inflammable, accumulates on the wick, and remains there in the form of a crust; therefore, if whale oil be used, it must be the cold-drawn, which may be distinguished by its transparency and pale colour. Whenever bad oil has been used, on changing it, the wick that has been used with it must also be changed.

If the lamp be trimmed in a morning, or some time before using, the dirt and other extraneous matter contained in the oil will subside.

A fresh piece of wick must be put in every two or three nights, and the burnt part cut off every night; and though the whole of the oil should not be consumed in one burning, yet the lamp ought to be filled up every time it is used.

The oil when not in use should be well corked up, and the wick and every thing belonging to the lamp kept as clean as possible.

The roughened glass chimnies are best cleaned with soap and water; and the others may be rubbed with a piece of washed leather.

I shall now point out those improvements which I claim separately as my own.

First. The additional length of the wick-tube, or its reaching to the bottom of the lamp.

Secondly. The contrivance at the bottom of the wick-tube for giving room to the wick, and preventing it from sliding down. This contrivance admits of the tube being made wide.

Thirdly. The additional width of the wick-tube.

Fourthly. The shape of the chimney or lamp glass.

Fifthly. The manner of placing the chimney, or its application to lamps of any construction.

Sixthly. The manner of supporting the same.

In witness whereof, &c.

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OBSERVATIONS BY THE PATENTEE.

Light may justly be considered as one of the necessaries of life, and it is of so much importance, and composes so considerable an article of expense, that every improvement tending to facilitate its use, and economise its consumption, certainly merits the attention of the public, and is an object equally interesting to the student, the man of business, and the mechanic; but at the same time it must be acknowledged, that a cheap useful lamp, suitable for every situation, is still a *desideratum*. In hopes of supplying this deficiency, C. Seward presents to the public his patent improved lamps. These lamps are made of tin, brass, silver, and other metals. They are constructed of various forms, according to the purpose they are intended to answer. They are used either with or without a chimney or lamp glass. This chimney is upon an improved construction, and not liable to be broken by the flame.

There are many advantages peculiar to these lamps: they burn the most common oil without the least smell or smoke, and at the same time give a bright and clear light. They may be used in any situation, and are equally eligible for the manufactory and the drawing-room. Their simplicity, the ease with which they are managed, and the great saving of expense, render them proper to be used for every purpose, and in every situation where light is required. It may be proper to observe, that, from the simplicity of their construction, these lamps are capable of being made to assume the most elegant forms, and are susceptible of being easily ornamented; which in this age of refinement are no small recommendations.

The Patentee begs leave to recommend chimnies of roughened glass, as they not only render the light mild and agreeable, but what is of the greatest importance, they certainly preserve the eyes, in protecting them from the direct rays of light proceeding from the vivid and dazzling flame of the lamp. It is a common, though erroneous opinion, that a considerable quantity of light is lost in passing through shades of roughened glass. A little reflection will convince those acquainted with the principles of optics, that in this case there is very little actual loss, but only a dispersion of the light.

Specification of the Patent granted to ZACHARIAH BARRATT, *of Croydon, in the County of Surrey, Gentleman; for a Machine for Washing Linen and Cotton Clothes, and other similar things; to which there may be affixed or omitted at pleasure, a Contrivance for pressing the Water from them, now commonly done by wringing.*

Dated October 31, 1808.

With Engravings.

TO all to whom these presents shall come, &c. NOW KNOW YE, that in compliance with the said proviso, I the said Zachariah Barratt do hereby declare that my said invention is described in manner following, that is to say: I construct a wooden trough of a convenient size for one person to stand at, with an inclined bottom, and I make an uneven surface on the inside of the trough by forming grooves or projections thereon, taking care to leave no sharp angles that may catch, and thereby damage the things put into the machine, and at certain convenient distances, say about an inch asunder, I hollow out the ribs of the grooves so as to give them a wavy appearance, and into these hollows I sometimes introduce small pieces of buff or other leather, or other elastic or suitable substance, of about two inches long and about an inch wide, which in the operation of washing are presumed to act similarly to the human fingers. These elastic pieces are not absolutely necessary, though the washing is better performed with than without them. A hole should be made in the bottom of the trough to let off the suds when done with. On the inside of the trough, and parallel with its ends, nearly about the top, I fix on centres a roller either partially or entirely covered with cork, leather, or some soft substance, to prevent noise in the operation of washing; which operation is performed by a person pressing the cloaths in the trough with a loose board, Fig. 5 (Plate VI.), called an agitator, the under side of which is supported by, and moves on the roller above mentioned. This agitator is constructed of one or more pieces of board of about two feet six inches in length, framed together so as to form a flat surface nearly of the width of the interior, having two holes or spaces cut out in the upper end for the operator's hands. The lower end, about an inch high, is covered with leather, cork, or other fit elastic soft material, with one or two pieces projecting at the bottom, similar to those in the hollow parts of the grooves in the inside of the trough. I fix across the top of this trough a strong bar or shelf of wood, on which when required I place an apparatus of any proper construction for pressing out the water from the things that have been washed, to be used instead of wringing them by the hand, in the mode now commonly practised.

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Pl. VI. Vol. XIV. Second. Series.

Fig. 1.

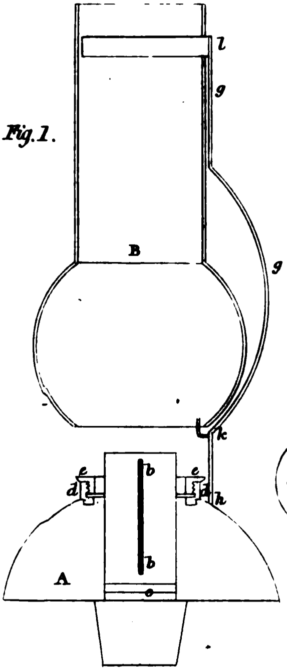


Fig. 2.

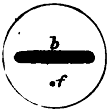


Fig. 3.

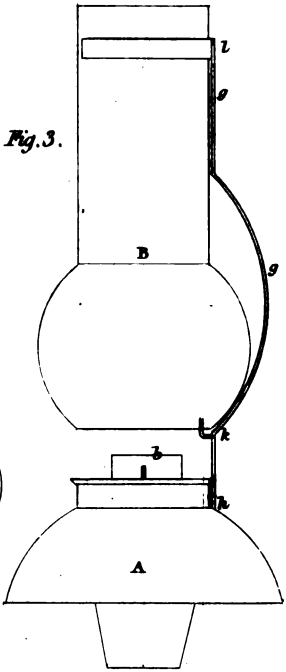


Fig. 6.

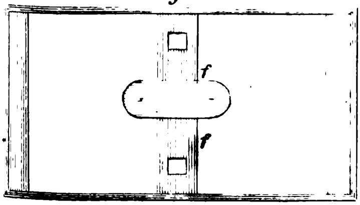


Fig. 7.

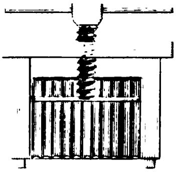


Fig. 4.

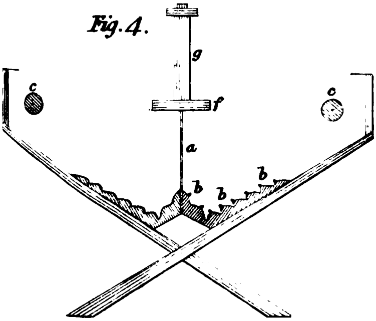
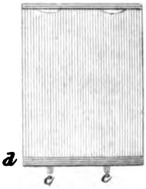


Fig. 5.



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In the margin of these presents is shewn an apparatus of a simple construction for the purpose above mentioned; it is merely a box or tub, into which the wet things may be put, and the water pressed out by a piece of wood (of the size nearly of the interior of the box) attached to the end of a screw fixed in a frame, as exhibited in the drawings. But a lever, or any other means of creating a pressure on the wet things may be adopted, as fancy and convenience may suggest, though if the screw be employed, as shewn in the drawings, it should be encircled to a convenient height with a cylinder of leather, or other proper material, to keep it free from wet, which would render its action stiff and unpleasant.

Fig. 4 (Plate VI.) is a transverse section of a trough divided by a partition *a*, so as to form a double machine, one side having leathers *b*, inserted in the hollow parts of the grooves, and the other without any leathers; *c c* the rollers on which the agitators work; *g* end of pressing apparatus.

Fig. 5 shews one of the agitators; *d* the lower end of the agitator covered with leather, under which I sometimes put cork; *e* projecting pieces of leather.

f Figs. 4 and 6, the cross-bar, on which the pressing apparatus may rest.

Fig. 7, the pressing apparatus (grooved at the sides and bottom, which form holes to let the water out), into which the wet things are to be put to be pressed.

Fig. 6 is a view of the top of the double machine, Fig. 4.

A single machine, consists of a trough similar to either of those on the sides of the partition *a* Fig. 1.

In witness whereof, &c.

Specification

Specification of the Patent granted to SAMUEL CRACKLES, *of the Town and County of the Town of Kingston-upon-Hull, Brush-manufacturer; for a Method of making and manufacturing of Brushes from Whale-bone, which have heretofore been usually made and manufactured from Bristles.* Dated November 3, 1808.

TO all to whom these presents shall come, &c. NOW KNOW YE, that in compliance with the said proviso, I the said Samuel Crackles do hereby declare that the nature of my said invention, and the manner in which the same is to be performed, is described and ascertained in the following explanation thereof; that is to say: Take the bone which comes from the mouth of the whale, and boil or steep it in water for such a length of time as the nature of the bone may require to make it soft and flexible; in which state it may be cut with a plane, knife, or other sharp instrument, engine, or machine, into thin shavings, slices, or substances, which may be split, cut, or torn, by having lances fixed in front of the plane, knife, or other sharp instrument, engine, or machine, into small pieces or substances, as near resembling bristles as may be; and may be made thicker or smaller in the splitting, cutting, or tearing thereof, so as to render the brushes to be manufactured therefrom more hard or soft, according to the different purposes the same may be respectively intended. And for the more convenient boiling or steeping, and working the bone in manner aforesaid, it may in the first instance be cut into lengths of about nine, twelve, or eighteen inches, when it will be found to work with greater ease and convenience than otherwise. When the bone is brought by the above process to substances resembling bristles, it must be laid in a convenient place, that it may become perfectly dry, which it will in general be in half a day, or thereabouts; and then it may be used and substituted in the place and stead of bristles, and brushes may be made and manufactured, and used in every other respect as those brushes which have heretofore been usually made and manufactured from bristles only; those that are to be set with pitch may be seared or singed at one end with a hot iron, to make them resemble the roots; and beat at the other to make them resemble the flag of the bristle.

In witness whereof, &c.

Practical Rules for finding the Strength of Timber. Deduced from Dr. YOUNG'S *Lectures.*

Communicated by a Correspondent.

I. TO find the number of hundred weights that will break a beam of oak supported at both ends, if placed on the middle.

Rule.

Multiply the square of the depth in inches by 100 times the breadth, and divide by the length.

Note 1. From $\frac{1}{4}$ to $\frac{1}{3}$ of this weight may be safely supported in practice.

Note 2. If the weight be equally divided throughout the beam, the strength will be doubled.

Note 3. Fir is probably a little weaker than oak.

II. To find how much a beam of oak or fir will sink when it is loaded in the middle.

Rule

Rule 2.

Multiply the cube of the length in inches by the given weight in pounds, divide by the cube of the depth, and ten million times the breadth.

Note 1. This sinking is independent of any fixed setting of the wood, which will often be occasioned by it: and the inequality of the wood will often cause the sinking itself to be at least twice as great as the calculation.

Note 2. The rule is the most correct for fir: oak sinks a little more.

Example 1. Let the depth be 6 inches, the breadth 3, and the length 120.

Square of the depth		36
Breadth ×100		300
Length	120)	10800
		90 cwt.

Whence the load may be from 10 to 20 cwt. in the middle, or from 20 to 40 divided equally.

Example 2. Let the same beam be laid on its flat side.

Square of the depth	9
Breadth ×100	600
	5400

Which is half as great as before.

Example 3. Let the first beam be loaded with 2000 pounds in the middle.

Cube of the length 1728000
Weight.................................... 2000

Cube of the depth .... 216) 3456000000

Breadth .... 3) 16000000

10000000) 5333333

.53

Or a little more than half an inch; and in practice a sinking of an inch may be allowed, besides the setting.

Example 4. Let the flat be loaded with 1000 pounds only.

Cube of the length 1728000
Weight 1000

Cube of the depth .... 27) 1728000000

Breadth .... 6) 64000000

10000000) 10666666

1.067

Twice as much as before, although the load bears the same proportion to the strength.

See Young's Natural Philosophy, vol. II. pp. 48. 50. 169.

Description

Description of a Machine for closing Boots and Shoes in a standing Posture. By Mr. A. STASS, *of Porter Street, Newport Market.*

From the TRANSACTIONS of the SOCIETY for the Encouragement of ARTS, MANUFACTURES, and COMMERCE.

With Engravings.

Fig. 1 (Plate VII.), *a*, the clamp or boot-holder, having a cross joint acting within the block *b*, more plainly shewn in the section of the block at Fig. 3.

c a strong piece of wood firmly fixed in the table, having three holes or mortises to receive the tenon of the block *b*, and thereby to alter the position of the clamp or boot-holder: the sloping one is for sadlers-work; the other two, being one over the other, are to raise or lower the work to suit the height of the workman; *d d* the lower arms of the boot-holder; *e e* straps from the pedal *m*, joined to the arms by small hooks, by which means the foot being pressed on the pedal, tightens the work in the boot-holder; *f f* a box or table with a drawer under it.

g a crossing strap, serving for the pedal strap, to be fastened to when the boot-holder is placed obliquely.

Fig. 2, a side view of the boot-holder and block.

Fig. 3, a section of the joint in the block, one arm of the clamp or boot-closer being mortised through the other.

Fig. 4, a side view of the table with a half round arm *h* (mortised into the post *i*), having a strap *k* reaching down to the pedal to hold the work on; *l* another mortise for the post *i* to turn the work the other end foremost.

Fig. 6, a section of the block *h*.

Fig.

Pl. VII. Vol. XIII. Second Series.

Fig. 8.

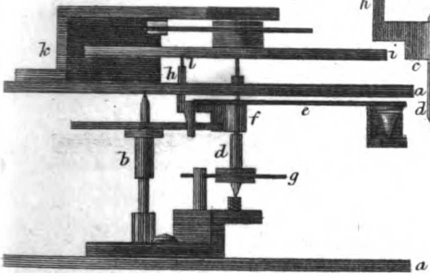


Fig. 9.

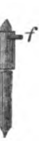


Fig. 10.

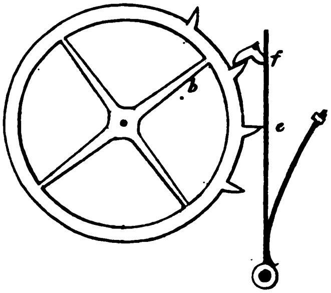


Fig. 2.

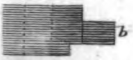
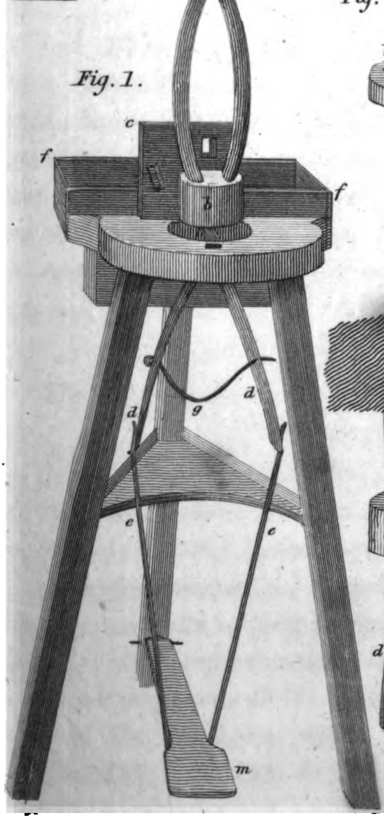


Fig. 1.



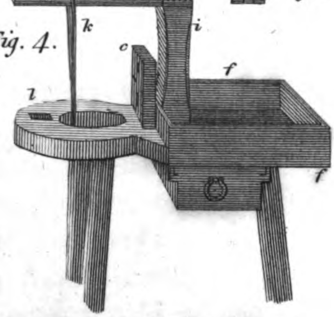
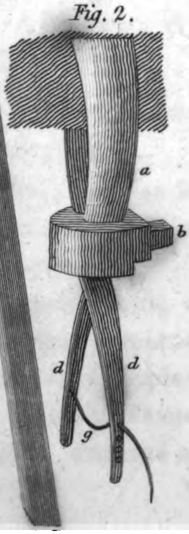


Fig. 4.

Fig. 6.

Fig. 2.



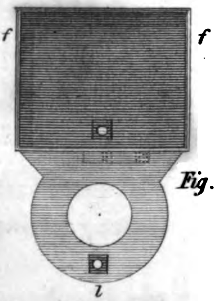


Fig. 7.

Fig. 3.

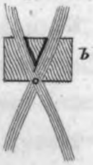


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Fig. 7, a plan of the table, shewing the two mortises of the post *i*.

Several persons have given their testimony to the utility of the machine.

Description of a Watch Escapement, invented by Mr. S. MENDHAM, *of Counter Street, Borough.*

From the TRANSACTIONS of the SOCIETY for the Encouragement of ARTS, MANUFACTURES, and COMMERCE.

With Engravings.

I BEG leave to lay before the Society, a model of a new escapement, the principle of which is, that the balance acts without friction, and the movement in itself very simple; the impulse is given without jarring, the inequality of power through the train has no perceptible effect on the balance; and no additional weight, however great, can produce more than a regular and gentle increase of impetus on the balance.

The following Letter is from Mr. THOMAS RAMSAY, *of Islington.*

Having attended the Committee upon Mr. Mendham's escapement, I think it a justice due to a man of genius, to give my opinion further upon it.

In viewing mechanical improvements, we should not confine our ideas to their present properties, but should consider what improvements the principle will admit of.

As the principles of Mr. Mendham's escapement, and that of Mr. Mudge's, which obtained a bounty from government, are much the same, I shall compare the one with the other.

The impulse given to the balance without friction, is exactly the same as Mr. Mudge's. The remontoir is bent up by the maintaining power in a similar way to that of Mudge's, but from the form of the pallet, which is a plain surface, it is not so perfect. Mudge's, from the form of the pallet, bends the remontoir always to the same place, the other is bent higher or lower according to the force of the maintaining power, but by forming the pallet like Mudge's it would render them alike in that respect. The only other objection is the spring detent that detains the wheel, when it drops from the pallet of the remontoir; it is the same as that of a detached escapement, consequently exposed to the whole force of the maintaining power. To compensate for these objections, the arc of vibration is not limited like Mudge's, which is of great importance; and having only one remontoir, it is more simple. It is, therefore, superior to Mudge's in having only one remontoir; and being unlimited in the arc of vibration, it is superior to the detached escapement in giving the impulse without friction.

In the escapement referred to, there are two principal peculiar properties in the invention, both which I consider superior to any thing of the kind laid before the public; first, the balance is kept in motion without any friction whatever, and in a manner so simple, that even movements of inferior workmanship must go with great accuracy.

Being not in this line of business, or acquainted with any persons in the trade, where I might have had an opportunity of examining different escapements, I certainly labour under many disadvantages, for since I have been honoured with the Society's medal, I have heard of an escapement by which the balance is kept in motion without friction, but being limited in the arc of vibration, complicated, and very expensive in the movement, it renders it much inferior to mine.

In the second place, the balance is kept in action by an impelling power without any blow whatever; all other escapements which have fallen within my notice have kept up the vibration by a direct blow, virtually on the balance itself, which I have always considered to be a great disadvantage, for a blow upon any thing of the nature of a spring, produces that kind of shock which can by no means be convenient or serviceable in keeping a steady motion, which is so essentially necessary, but is on the contrary disadvantageous.

The figure, Plate VII. Fig. 8, represents the escapement without the rest of the train; *a a* are the two plates of the frame between which the train runs; *b* is the last or balance wheel of it, with teeth nearly similar to that of the balance wheel of an eight-day clock, moving with the flat face of the tooth forward against the pallet *c* of an upright spindle *d*; *e* is a locking spring nearly similar to a detached one, having no extra spring to pass to and fro with. Above the pallet *c* is a very small one *f*, which is for the purpose of unlocking the wheel, which is better shewn in Fig. 9; at the lower part of the spindle *d* is a hair spring *g*, so pinned as to bear the pallet *f* against the locking spring with

sufficient

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sufficient power, so that of its own accord it frees the wheel and lays the pin *h* which comes through the plate gently up to the stop, consequently the tooth falls upon the pallet *c*, but so close home to the centre of the spindle that it has no power to pass of its own accord; the pin *h* referred to is fixed to the top extremity of the pallet *c*, and rises perpendicularly through the plate *a* some way above the surface.

The balance *i* is fixed on the centre of its spindle, principally on account of equalizing the weight, besides which it is the most convenient to be so; it is supported between the plate *a*, and the cock *k*, precisely over the spindle *d*, consequently the action of each is in the same arch, and the connection is between the pin *h* of the pallet, and the pin *l* of the balance (a pin fixed in the balance at the same distance from its centre as the pin *h* is from the centre of the spindle *d*, and sufficiently long to touch the pin *h* sideways), there is therefore no friction whatever between them.

Having mentioned the different parts of the escapement, I shall proceed to explain its action. The immediate course of vibration is from the spring *g*, the balance spring is so placed that the pin *l* of the balance stands near the pin *h* of the pallet; it is to be remembered, that the tooth of the wheel rests on the pallet during the vibration of the balance, so that when the balance is put in motion the pin *l* comes in contact with the pin *h*, which stands perpendicularly, almost imperceptibly fine, and carries it back; as soon as moved, the tooth of the wheel gives it an extra assistance of about one-fifth of a circle, passes and lays the next tooth on the lock; on the return of the balance, th spring *g* applies all its power in urging the balance forward till it comes to the stop, the balance then maintains its motion, and the small pallet *f* having unlocked the wheel, the tooth falls again on the great pallet *c*, and waits the return of the balance.

The balance carrying the piece *h* back forms a most admirable banking without any extra apparatus, which is generally done by some kind of stop on the hair spring, which must have an irregular effect; the farther the pin is carried back, the stronger the spring operates against it, and from the extent where the piece may be forced back to, there is play for near two whole circles of vibration, without any possibility of upsetting. The balance of the model vibrates about a circle and one third with extraordinary freedom, *though* a course train of four wheels, a large and heavy balance, with only the power of a stout watch spring. I therefore think the power necessary to carry a train with this escapement, may be considerably less than any other of a detached nature.

Fig. 9 represents the axis *d* shewn separately, in order that the arm and pin *h*, and little pallet *f*, may be seen more distinctly.

Fig. 10 shews the balance wheel *b*, and the method of locking and unlocking.

A Treatise on the Diseases of Sheep; drawn up from original Communications presented to the Highland Society of Scotland.

By ANDREW DUNCAN, *Jun. M.D. F.R.S.E. and A.L.S.L.*

(Continued from page 118.)

SP. 4. Sometimes on opening the belly the whole bowels are found swimming in bloody water, although none of it is contained in the intestines. The gall-bladder is contracted and shrunk to a size scarcely observable, and is almost empty of bile. The membranes connecting it with the other parts are inflamed. The urinary bladder is always empty, but Mr. J. Hog did not find it to be ruptured in the cases which he examined, as from the Rev. Dr. Findlater's observations he had been led to expect. The smaller apartment of the stomach had some purple spots on it which were thicker than the rest of its substance. In this variety, the peritoneum covering the whole intestines, and lining the cavity of the belly, is the seat of the disease, which then would be *peritonitis*.

It may be known during the life of the animal by the swelling hanging low instead of rising up at each side of the back, as in the first species, and by an evident feeling of fluctuation when the one hand is applied flat to the one side of the belly, while the opposite side is struck by the palm of the other hand.

B. *Sickness in the Flesh and Blood.* — Sp. 5. " In some instances of the disease, and these the most violent, no *one* part of the stomach or bowels seems to be more affected than another. There is a general redness over the whole, and the flesh of the animal is quite tender and soft, soon assuming a greenish hue. In this case *(phrenitis?)* the brain partakes of the affection, and its vessels are red and turgid, exhibiting, with the exception of the blackness, the same appearance as that mentioned in the bowels. In all cases where this is observed after death, the disease has been very quickly fatal, seldom exceeding four, or at most six hours from the first apparent affection." Mr. Stevenson.

Sp. 6. "That species of sickness which is seated in the blood is not so readily discerned in the living animal; nor does it affect the carcase so much if blood be let. There seems to be a tendency in the blood itself to decompose and putrify, and not unfrequently there are appearances of inflammation on the membrane lining that lines the breast *(pleuritis)*; or on the diaphragm *(diaphragmitis)*, and the distemper has a strong resemblance to pleurisy." Rev. Mr. Singers.

These two species, if indeed they be distinct species, are both included by the other writers under the same denomination, and it is therefore scarcely possible to ascertain to which of them their observations belong. Mr. J. Hog says, that the whole body is *hoved* and swelled like a loaf, that the fore legs are certainly the worst, that the kidneys are in the same state of mortification as in the two first species, that the symptoms and the smell are the same, that they are carried off by it in the same short space of time, and that it is the same disease with the *black spauld*, which prevails among the young cattle in the west of Scotland when the grasses fail, and they begin to feed on fodder and dry herbage. He also observes, that all the old sheep which die of the sickness, as well as the hogs which fall in May, are carried off by this species, although individuals die of it at the same season, when they are dying in great numbers of the bowel-sickness. On the whole, however, the mortality is not nearly as great, not indeed above one-tenth, or one-twentieth of that occasioned by the other.

Causes of Sickness.—Although a few old sheep and lambs occasionally perish from the sickness, it may be considered as a disease peculiar to hogs, and the sounder that hogs are bred, and the higher condition they are in, the more apt is the sickness to break out amongst them, the more violent are its ravages, and the sooner do they die when attacked. Heath sheep are also supposed to suffer more from it than the white-faced and fine-woolled breed. When it sets in severely, it is not uncommon for one-tenth of the young sheep to be carried off by it. But as it is not half so fatal to hogs which are allowed to pasture with their mothers as to those which are hirseled or reared by themselves, it is proper to notice in this place the manner in which these plans affect the habit of the animal. By hirseling, they turn out more uniform in shape, size, and condition, but they acquire a dullness and inactivity which does not leave them till next season, and then not entirely. They are also deprived of the experience of their mothers, and feed injudiciously, gathering in crowds, and indulging in the richest spots of their pasture, remaining all night on their layers without rising to eat, or to pass dung or urine, and next morning devouring to excess any thing that comes in their way; they are less capable of sheltering themselves in storms, or finding food when the ground is covered with snow; and are less able to support the hardships of winter, losing their high condition very quickly. Their constitution also is enfeebled, and does not last more than six or seven years.

On the contrary, by adopting the more natural plan of allowing them to follow their mothers, they benefit by their experience, both in sheltering themselves in severe weather and in their manner of feeding, rising along with them to feed an hour or two every night, and in the morning, after cropping a moderate quantity of rich grass, setting out of their own accord to the upper parts of their pasture. They thus become more active and vigorous, suffer less from the severity of winter, and acquire a constitution which lasts for eight or nine years.

Notwithstanding some sheep die of sickness in all seasons of the year, its ravages are almost entirely confined to the winter-months, and commence sooner or later, according to the state of the weather. It is not frequent till Martinmas; and if considerable numbers die before the time of smearing, it indicates great loss from it through the winter. It seldom prevails until after the vegetation has been checked by frost in the month of October, and it is most destructive in November. When at that season there is any sudden change from mild weather to frost, or if rainy days are succeeded by frosty nights, especially when accompanied by hoar-frost, it is particularly fatal; so much so, indeed, that in going out in the morning the shepherds will put on old clothes, as they expect to have some of their hogs to carry home. It becomes less frequent after steady frost sets in, but again carries off a few in May; and Mr. W. Hog says, that he has invariably observed, that deaths are more frequent a day or two before the weather actually changes.

"The sickness may be immediately brought on by means of frozen grass. It is dangerous for the young sheep to haunt through night among those spots of ground where frost mists settle deep on the softer grasses. But in dry pastures they are more eager to get at these spots than in green walks, being urged to seek after the most succulent grass to abate thirst, and the hollow spots of a dry sheep-walk, on a southern declivity, are very likely, when in any degree moist, to be heavily loaded with hoar-frost. The effects of grass eaten in that state on the tender bowels of the hog sheep, resemble those of frozen potatoes eaten by black cattle, which immediately engender astonishing quantities of noxious gases, and quickly bring on inflammation and mortification." Mr. Singers.

Another immediate, and often very destructive cause of sickness, is, when they are obliged by a heavy storm of snow to work and eat on places already bared and fouled; for in these circumstances they eat any thing which comes in their way, as rotten fern, spratt, fog, roots, or whatever they can reach.

Pet sheep, and others that have night shelter, are said by some to be seldom affected by it; but Mr. J. Hog asserts that he has seen many instances of domestic sheep, called pets, dying of the sickness; and that in the counties of Ross and Sutherland, where many of the small tenants house their sheep every night of the year for fear of foxes, the sickness rages with uncommon severity.

With regard to soils, the hardest, driest, and soundest, such as ley heather, are most subject to sickness. Such pasture has the same effects upon them as corn has upon horses. Their bellies are lighter, they run faster, they keep their wind longer, they are of a hot, dry, and costive habit, and are subject to inflammatory diseases. Ley

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Ley heather in general grows in bushes, and is remarkably strong and heating, while around its roots the grasses are of the softest and most delicious kinds. Indeed, all kinds of pasture, of which one part is fine and another coarse, are liable to great loss from sickness. Sheep are remarkably fond of sweet juicy herbage; any spots of it therefore soon become eaten, trodden down, and foul; but this does not hinder them from occupying these favourite spots, and filling their stomach with raw watery food, plentifully intermixed with impurities. Hence the danger of the grass growing round mole-hills, on the banks of rivulets, &c. and of grass the produce of sheep tath, such as that of old sheep-walks, and especially of what is called the hog-fence. Tath-grass they nauseate until it has been affected by the frost, when they eat it in quantities evidently dangerous to them.

Cure of Sickness.—This disease may almost be said to be incurable, for even if we were possessed of a specific against it, as Mr. W. Hog justly observes, it would avail us but very little, as one half of the sheep attacked by it are dead before they are discovered; and when they do recover, it leaves them in such a state of weakness, that they have little chance of surviving the severities of winter and spring. Notwithstanding this, numberless remedies have been at different times extolled as certainly successful; but, as might naturally have been expected, they have fallen into neglect. Some of them, indeed, such as the exhibition of whisky, could only aggravate the disease. If in any instance a cure is at all possible, it can only be effected by such means as are calculated to counteract inflammation. Of these, blood-letting is chiefly to be relied upon, and the veins at the tail, inside of the foreleg, and angle of the eye, may be opened. At the same time, refrigerants, such as nitre; or cathartics, as Glauber salts or common salt, castor oil, infusion of tobacco, may be exhibited, either by the mouth, or tobacco-smoke in the way of glyster. If the blood should flow freely, and purging be induced, recovery may be expected.

Mr. James Hog recommends another mode of treatment, from experience. "The only cures which I can freely recommend are in every shepherd's power. 1st, If the animal be found in time, let him give it a severe heat, by running; and if this do not cure it, nothing I am acquainted with will. However unfavourable this may appear, let him hunt it well, and follow after it, that it lie not immediately down on leaving it, or if it will lie down, let it be in a house. Many shepherds have discovered this by chance, who yet are ashamed to be the first to own it."

"The next is bathing among warm water for the space of ten, or eight minutes at least; when a quantity of water gruel, mixed with butter or some softening ingredient, may be given them as an injection or otherwise. Care must, however, be taken that none of these is administered for the water-braxy, because either of them occasions instant death."

Prevention of Sickness.—Since so little can be done in curing this disease, our principal efforts must be directed to prevent it. This is most effectually done, as has been already stated, by pasturing the hogs among the old sheep: where, however, this cannot be practised, and the hogs are hirseled, it is of material consequence to provide against the season of sickness a supply of green succulent food. Indeed, this disease "sets in early or late, in proportion as vegetation ceases early, or continues until a later period of the season. This is now perfectly well ascertained, and generally acknowledged; and likewise, that all kinds of food which preserve a continual vegetation are effectual preventives: such are clover, turnips, sea-marsh, and the dark-coloured tath which grows in abundance on drained ground that has formerly been marsh. This last being so green and soft, and continuing to vegetate at all seasons when the weather was mild, induced many people to believe that it was of a flatulent nature, and would increase the malevolence of the sickness; but experience soon evinced the contrary, and that in proportion as this grass was nourished by the prevalence of the draining scheme the sickness by degrees disappeared." Mr. J. Hog.

A moderate use of turnips is also almost a certain preventive. "Small turnips," says Mr. Singers, "on coarse moor-land answer very well; or if the larger turnips are drawn, the smaller ones may be left for the sheep; or a few may be taken out of any field at pleasure, and thrown down on any barren spot which it is wanted to improve, the sheep being conducted thither for an hour each day. The effects of these easy and simple modes of preventing sickness are really encouraging. Mr. George Brown, of Caldholm, on the lands of the Duke of Queensbury, has tried it for several years with a success greater than he himself expected. Mr. William Johnston, at Mollin, on the estate of the Earl of Hopetoun, has also found it beneficial beyond his hope. These two farms were severally tried with this distemper; and it consists with experience, that their losses have been considerably reduced. But these instances are only two out of many."

The protection of stone walls, especially when that of forest trees behind them is superadded, is also of material consequence.

Care should also be taken at no time to overheat them, nothing is more apt to injure sheep in high condition.

The margins of rivulets, and other places abounding with rank grass, should either be inclosed, or cut down for other uses. The molehills also should be carefully spread. But, although every precaution must be taken to prevent the hogs from eating such succulent food to excess, starving is almost equally destructive; and in hard weather they should either be removed to the lower parts of the country, or hay and turnips may be given them upon the spot.

The number of hogs in one hirsel should seldom exceed five hundred, as at certain seasons it is almost impossible to do a greater number justice, and prevent them from doing hurt to each other.

Much may also be done by proper attention in the selection and management of the hog-fence. The part of the farm appropriated to this purpose should consist, as nearly as possible, of one kind of soil; and it is no great matter what the nature of the soil be, provided it be nearly uniform: it is but stocking it the lighter, and sheep will thrive as well upon coarse land as upon fine, if there are few or no sweet spots interspersed through it.

Mr. Welsh, while he approves of the general practice of saving the winter pasture intended for hogs, from the beginning or middle of August till the beginning of October, if they can be so long kept in a thriving condition, strongly reprobates, as a deliberate preparation for the braxy, the custom of previously eating it quite bare, by milking ewes, feeding cast lambs upon their mother's milk, &c.

If ley heather be unavoidably situated within the bounds of the hog's winter pasture, care should be taken, on the first opportunity that offers, to burn down every bush of it, by which means it will be converted from an incentive to a preventive of sickness; for the young sprouts which grow upon burnt ground are generally laxative, and easy for the stomach.

"Experienced shepherds," says Mr. Singers, "have also found benefit from visiting their young sheep every morning at an early hour, when the approach of sickness is dreaded. If any danger arise from the degree of external cold, the sooner they get up and move about the better; and should the bladder be affected, the sheep may have some chance of relief, from rising up and passing their water, whereas by continuing on their layer this danger increases every hour."

Bleeding about Hallow-day is said by Mr. Campbell to be almost a certain preventive. He directs the hogs to be collected, about fifty at a time, and to be lifted, the fattest first, and laid upon a table, two boys holding them by the feet. On the other side of the table, having the animal's back towards them, and its head to their left hand, stands the bleeder and his assistant. The latter, with a pair of sheep-scissars, clips away the wool above the jugular vein, about the breadth of a crown-piece, and puts a soft woollen bandage round its neck, near the shoulder, until the vein rise. Then the bleeder, to prevent the vein from shifting, applies the fore finger of the left hand on one side of the vein, and his mid finger on the other, and holding the lancet between the finger and thumb of his right hand, with about half an inch of it uncovered, strikes it with a smart jerk into the vein, directing its point obliquely upwards. If the blood appears bright and thin, a wine-glassful is sufficient, but if dark and thick, double the quantity may be taken. The bandage is then to be removed, the lips of the wound brought together, and the hog's tail drawn backwards as it is set away.

"About Martinmas," Mr. Laidlaw very judiciously observes, "I have heard of the whole hirsel being folded, and doses of, I know not what, poured down their throats, no doubt some strong purgative, to free the creature of some of its *exuberant fatness!* which hath cost the anxious shepherd so much pains, and the intelligent farmer so much expense. I have heard also of chasing them at night, when setting them out to their layer, till they began to blow pretty hard; but for my part, I would rather choose to see them walk calmly, for this reason: any sudden and violent exertion of the animal powers rather obstructs than assists digestion. And sure I am, that many *feats* of this kind will waste both the flesh and constitution of the animal. In short, whatever preventives (I mean those of the drug kind) are made use of, they have all one tendency; that is, to make the creatures leaner. But it is surely very inconsistent to use every prudent method to fatten them at one time, and at another to disregard every thing but saving the life of individuals. And although some attempts of this kind may at times become proper, yet, generally speaking, such as use remedies of this kind may at least take a more profitable method. Keeping more sheep on the same bounds will effectually answer this purpose — save the expense of drugs — and give the profit of the extra sheep into the bargain!"

When

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When the sickness breaks out with violence, the best mode of checking it, is to give them turnips on their own pasture, or to remove them to some other situation, where they can get plenty of succulent food; but this expedient is attended with danger, and should not be resorted to unless there is a probability of very great loss; for although it generally puts a stop to their dying, it often begins again when they return back to their own pasture; and being removed at an improper time of the year, if the spring be hard and severe, poverty always sets in amongst them.

Cases of Sickness, drawn up by Mr. STEVENSON.

Case I.—In the month of November, the 18th if I recollect right, 1802, a young sheep was brought home by the shepherd, affected by sickness. The wool was clapped, the eye was languid, red, and watery. There was great heat over the body. The mouth was dry, the breathing quick, and somewhat difficult; the pulse beat frequent and strong, and its limbs seemed scarcely able to support it.

The tail was cut across in two places, when a considerable quantity of black thick blood flowed from it. As no Glauber's salts could be had, a handful of salt was given it, dissolved in warm water, from a tea-pot; it was put into the house, and the door shut. In about half an hour it was laid down upon some straw, and appeared very weak. On approaching it, it rose, but could scarcely walk. The tail was still dropping blood. In two hours after it was standing, and run away to the other side of the house when it was approached. The eye was rather more lively, the tail had ceased bleeding, and it walked without any difficulty. In two hours more it was eating some hay that had been given to it, and the salt had purged it very freely. It was kept in the house all night, and next morning, when let out to the park at the back of the house, it eat a little. The wool was still clapped, but the eye was lively, and the burning heat was gone off the skin. The purging continued all day; it was again put into the house at night. Next morning when let out it seemed quite well, eat very well during the day, and next day was sent to the flock. It had no relapse.

Case II.—On the 7th December 1804, another sheep was brought home. The shepherd had seen it affected in the morning, but it was not brought home till after dinner, on account of the distance. When brought home it could not stand, which we attributed to the tying of its feet, for the purpose of being carried home, a distance of nearly four miles.

The eye was dull, wool clapped, pulse quick and strong, mouth dry, breathing very quick, and a kind of palpitation at the heart. When the shepherd laid it down from his back, it made some water, which was red like blood.

On cutting the tail, two or three drops only of blood, black, and thick like tar, followed the incision, which, however, soon stopped. The vein on the inside of the fore leg was opened, from which also no more than two or three drops came, of the same black and grumous appearance. The ear was also cut in the inside, but little or no blood came from it. An ounce and a half of Glauber's salts were given, in half a mutchkin of warm water, and an old blanket thrown over it. In three quarters of an hour the tail was bleeding very freely, but the other places had stopt. The animal was lain

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lain down, and could not rise. The pulse was quick, and it was apparently very *sick*. In the evening, about two hours after, it was much in the same way, only the skin was not quite so hot. It got a little meal boiled in water, and the blanket was left on it during the night. On looking at it next morning, it was risen, but scarcely able to walk. The tail had bled a considerable quantity, and it would not eat. The wool was clapped to its body, and it still had a very languid appearance (probably from the blood it had lost). It got a little more boiled meal and water, and the salts had operated. In the afternoon it was eating a little boiled hay; and from this timeit gradually recovered, without any other application. It continued very weak for about eight days, when the wool was risen to its usual appearance, and it was sent to join the flock.

As the sickness did not appear in the flock, I had no opportunity of again trying the practice at that time.

Case III.—In the beginning of March, however, 1804, at which time the weather was very cold, a young sheep or hog was brought home in the afternoon, gasping for breath, pulse very quick, eye quite bloodshot, skin remarkably hot; had been observed not eating in the morning, and seemed even then remarkably languid, but made no motion as if affected with pain.

On cutting the tail across, a few drops of blood, like tar, followed, but stopt immediately; the ear was cut, the neck-vein was opened, the vein on the fore part of the belly, as was also that on the fore leg, from none of which above a drop or two came. A dose of salts was given, and it was covered with a blanket. On going to look at it about an hour afterwards, it was dead.

On opening the body, the fourth stomach was found mortified over all its upper and fore part, which extended to the place where it joins the bowels, which were all quite red, as were the stomachs in a less degree. The internal coat of them all was very loosely attached, and the smell was extremely disagreeable; there was a reddish or livid appearance over the whole body, which arose partly from the blood not having been drawn from the animal, but more particularly from the previous inflammation that had existed. The right auricle and ventricle of the heart were quite full of the same dark kind of blood as came from the incisions made before death, and the whole flesh was quite soft.

Case IV.—On the 14th November 1803, a young sheep was observed affected with sickness, belonging to a friend, during the time I was on a visit at his house. He had ordered it to be killed, alledging that sickness was uniformly fatal; but was easily persuaded to try something for its relief, as, if it succeeded, it might be advantageous in cases of a similar kind.

The appearance of the sheep upon viewing it was by no means favourable upon a trial. The wool was clapped, the eye was red, the pulse strong and full, the skin very hot, breathing laborious, with considerable wheezing, and it was scarcely able to stand. The belly was somewhat swelled, and the mouth quite parched.

It was bled, as has been described, in the tail, neck, fore leg, hind leg, belly, and ear, from which there was a little blood got, of a dark colour. As no Glauber's salts could be had, a handful of salt was given to it, dissolved in a tea-pot full of warm water, and it was left in a house by itself. In half an hour it was laid down, and we thought it dying. On going to it, it rose, but could not walk. The tail was bleeding pretty freely, and the blood flowing

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flowing from it was rather of a redder colour, the pulse was quicker, but not so strong, and the other wounds had bled a little; the symptoms were not increased, but did not seem better.

As there happened to be some saltpetre (or nitre) in the house, we gave it a tea-spoonful of it in another tea-pot of warm water, but reserved the half, which was afterwards given, at the interval of an hour, when the heat was rather less, and the skin somewhat moist. At the end of the second hour, it had made a considerable quantity of water, and seemed rather more relieved. In two hours more the salt had operated, and the wounds still continued dropping. It got a large tea-pot full of meal and water. Next morning it looked much better, but would not eat. In the afternoon, however, it eat a little boiled hay, which it lived on for two days, when it was put into a park by itself. In two days more it was sent to join the flock.

Case V.—In the month of April 1804, when the weather was unseasonably cold, on the 12th, a hog was brought in, affected with sickness. It was observed by the shepherd at mid-day, and was brought home in the afternoon. It was bled in the tail, from which a considerable quantity of blood came; it got a dose of Glauber's salts, and had two tea-spoonfuls of nitre dissolved in a chopping of boiling water, of which it got half a mutchkin every two hours. At bed-time the tail continued bleeding, and it seemed rather easier. On looking at it next morning, it was stiff, having died in the night.

On opening the body, the general redness apparent in sheep dying of the sickness was very observable: the bowels were all affected, but none of them seemed to be the immediate seat of the disease, as no mortification was apparent on any of them. The flesh of the body was all of a livid hue, and the inflammation seemed to be generally diffused over it. Black clots were found in the right auricle and ventricle of the heart, and the food in the stomachs might have rubbed between the fingers, like dry sand or chaff. There was also a redness observable in the brain.

I have had many more opportunities of making experiments upon sheep affected with sickness, a detail of which, after what has already been said, would be unnecessary. Taking the average, however, of those that have been affected, I have been enabled, by the practice laid down, to save three out of five. The proportion is even greater; but allowing for contingencies, such as their being nearly dead before being brought home, I have stated this as the proportion.

Number affected	25
——— died	9
——— recovered	16

Trembling, Thwarter, or Leaping ill. — These three appellations, of which the last is most common in Annandale, and the first in Selkirkshire and to the eastward, are now used as synonymous; but they are applied indiscriminately to all diseases which, on a dry soil, proceed from a debilitated state of body and barren seasons. "Under this triple name," continues Mr. J. Hog, "I have seen sheep suffering by diseases, which at least had much resemblance to rheumatism, ague, palsy, and apoplexy; and even when an old sheep falls down and dies of weakness and debility, the manner of their death differing somewhat from that of hogs, it is frequently ascribed by shepherds to the *trembling*, or *thwarter ill.*" In confirmation of this opinion, there is so much diversity in the descriptions of this disease, its causes, and method of cure, as given by Mr. Stevenson and the other gentlemen, that any attempt to reconcile them would only lead to confusion; and therefore it will be proper to consider them as distinct species.

Species 1*st.*—This disease is much more rare than formerly, and is scarcely known in the Highlands. It appears in spring and harvest. It affects sheep of all ages and kinds, but never when in good condition, and it exists chiefly on dry farms, having a northern exposure, which are evidently overstocked, and on these only when the spring is severe and dry, or when early April-grass has been cut down by frosts, and the sheep can find no succulent food or any thing green. Its production is favoured by a long continuance of easterly winds; and in cold weather ewes are sometimes attacked by it, even after they are fleeced. In these circumstances they become extremely emaciated, especially when many of them are heavy with lamb or giving suck; and "if at this time," says Mr. J. Hog, "they get an overstretch in running or leaping, or even a hasty start, or crush in the fold, numbers fall a prey to this disorder, or rather to these various disorders. Some will fall down and die in two or three minutes; others will lose the power of one side, and lie sprawling till they die of hunger; others again will lie shivering, and very sick at times, until death also comes on; and some will go a long time quite lame, carrying sometimes one limb, sometimes another, till they are likewise quite exhausted." Mr. W. Hog describes it as of two kinds, sometimes seizing the whole system, when there is a general trembling over the whole body, and sometimes affecting the legs only, when the animal immediately falls down, and the shaking, which is uninterrupted, is confined to the legs. Mr. Welsh says, that the animal gradually loses the power of its legs and body, until it becomes quite weak, always lying at last upon one side. Those which die of it in spring are lean and useless; but the mutton of fat hogs carried off by it in September is not uneatable. It is sometimes extremely fatal. In one instance, out of a flock of forty score, seventeen score were lost in one spring. It was formerly thought to be contagious; and although this can scarcely be the case, it is certainly most destructive when it first comes among a flock; and when sheep are brought from a clean ground to one infected with it, great numbers of them are sure of dying. Those which survive it one season are sure to relapse next spring.

Udder-locking, as has been already stated, should be entirely laid aside. Mr. J. Hog mentions one instance, where one-twentieth of a large parcel of ewes died of this disease in the course of a week after they had been udder-locked. It is also useful during the months of April and May to provide them with sufficient shelter and food; and to avoid overstocking if the early grass has been blighted, to pasture them in a rich park, or water-meadow, or on moss, and early rye-grass.

Various cures are recommended. When they fall down suddenly, and are threatened with immediate death, bleeding, by cutting the tail or opening a vein on the inside of the fore thigh, will sometimes give instantaneous relief. In all the other cases it is proper to take them home, and feed them with strengthening food; and if at this time they are attacked with a temporary

diarrhœa,

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diarrhœa, they recover very fast, and soon acquire their former vigour. Mr. Welsh says, that there are a few cures tried, but he believes with little success. Dipping in cold water is often practised. Whisky and gunpowder is poured down their throats. Balls of mustard and hot pungent medicines are often administered. The Rev. Mr. Singers recommends bringing them into the house, giving them a mixture of equal quantities of warmed sallad oil and spirits, with a little finely powdered ginger, at the same time rubbing into the back a little black soap broken in warm water, and feeding them on hay, the produce of dry walks.

Mr. James Hog also mentions the uniformly successful treatment of sheep affected with this disorder during summer and autumn, by giving them a decoction of the *dew-cup* and *healing-leaf* boiled in butter-milk.

Species 2d.—The second species is so particularly described by Mr. Stevenson, that it will be sufficient to quote his account of it.

"This is a disease which is chiefly confined to the flocks in the south of Scotland, more particularly about the banks of the Tweed, and of those rivers which discharge themselves into it. It is a complaint almost unknown to the farmers on the Pentland range, and to the north of the Forth.

"In those places where it prevails, it is sometimes peculiarly fatal, and a farmer often loses more of the flock by this alone than all the other diseases put together.

"When this disease first comes on, which is generally during the summer or harvest months, the animal turns somewhat stupid and neglects its food, doses round as in the sturdy, and frequently leaps up, as if to clear any bush or dike before it; at times it will eat voraciously, and again refuse all sustenance for a considerable time. It continued leaping frequently during the day, and the neck is frequently stiff, and turned to one side *: convulsions take place in the limbs, which make the animal fall down, make curious contortions, and at times run to a little distance: the body sometimes partakes of these when the animal turns totally incapable of motion, and dies from want of food, which the jaws will not open to admit, being closely wedged together. In this state it is unable to follow the flock, and the wool claps to its body. It lies for a long time motionless, and at length dies. After lying motionless for a considerable time, in those cases where the disease is not so violent, and the spasm of the jaw not so severe, it gradually relaxes, and they will eat the whole of the food within their reach, although the power of the limbs is totally gone. They will so completely eat all the grass, that they will leave the earth quite red all around them. If the shepherd is attentive, and lifts them from one place to another, and the season pretty well advanced, they slowly recover, and again are restored to the use of the limbs. When they lie in the inactive state mentioned, if the weather is warm, maggots are very apt to breed in them; and if not attended to, soon destroy them.

"This disease appears commonly during the summer and harvest months, especially during hot and sultry weather, and arises either from the sheep being put into violent motion by dogs, or overheated by the sun; in which case, in a few hours after, it makes its appear-

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* The sheep are often affected with wry necks, without any of the other symptoms, which may be considered as a lesser degree of the same disease.

ance by the stiff neck, or some of the other symptoms coming on. When the sheep are exposed to fatigue it will take place, if the weather is warm, independent of violent motion.

"It is generally the *fattest* of the flock that are cut off by it.

"This disease arises often from the braxy, and is generally a favourable symptom. It is never severe, however, when it is a consequence of braxy, and the stiff neck never accompanies it.

"On opening the head of those that die, the vessels of the brain are slightly turgid and red, which, however, is always the less the longer the disease has continued.

"As the disease arises from the brain being oppressed, by too much blood being sent to it by the quickened circulation, the first thing to be attended to on the appearance of the disease is copious *blood-letting*, which will be more effectual if taken from the veins of the neck, or from a vein in the outside of the eye, generally well known to shepherds. It may even be taken from the tail or fore leg; but the veins of the head being opened, is generally considered to be most effectual in this complaint. As there is too great a determination of blood to the head, it will be attended with advantage to make a determination to the bowels, by stimulating them by purgatives, such as Glauber's salts an ounce, calomel ten grains; or, what is more proper, as it also acts on the kidneys and skin, a dose of half an ounce of nitre. These must be persevered in till the symptoms disappear. But if the animal is too far gone in the disease, and has lost all motion, it should be killed for the sake of the carcase, which in this disease is not affected, or at least but slightly."

Cramp of the Legs.—"This has by some been denominated the *wood evil*, from its generally arising from the drippings of trees in cold and wet weather. It seizes the legs of sheep, and makes them totally incapable of walking, and will at times spread through the flock at once. In this disease, the action of the nerves of the legs seems to be so much impaired by cold as to destroy their energy.

"Mustard has been recommended to be given internally, a tea-spoonful night and morning. But the most effectual method of removing it, is to rub the parts affected with warm flannel, and keep the sheep dry. A little oil of turpentine may be used externally with advantage, if the rubbing does not otherwise succeed." Mr. Stevenson.

Sturdy.—The *sturdy* is a disease of considerable importance, both on account of its frequency, and because it always proves fatal, unless when relieved by art. Two varieties have been described.

Variety 1st. When a sheep is attacked with this species of *sturdy*, it ceases to improve, becomes dull, is apt to loiter behind, and separates from the flock. It does not walk straight forward, but often deflects to one side, or dozes round in a circle. The eyes glare steadily in its head, and seem enlarged, from the pupil being round instead of oval, which in healthy sheep it always is in the day-time. Its vision is impaired, and it does not see any object which approaches it until it be very near, when it starts away, and runs furiously without any aim. When caught, it is remarkably stupid on being again liberated. In dry weather it follows eagerly to that quarter from which the wind blows. It has a great reluctance at passing water, and burns, and cannot

not easily get through it, but mostly frequents places where it can hear the sound of water. Some time after these symptoms appear, in the course of perhaps three weeks, on examining the head by pressing with the thumbs, a remarkable degree of softness is found at one part of it, where the skull seems to be wanting. In a few instances no softness is to be discovered in any period of the disease; but in either case, if not relieved by operation, the animal loses the power of standing, and dies perfectly emaciated. The duration of this variety of the disease extends from two months to a year.

Variety 2d. There is, however, another variety, much more rapid in its progress, in which a great degree of stupor comes on in a few days, followed by total blindness, and no softness is ever to be found in any part of the skull.

Appearances on Dissection.—Variety 1st. On opening the head in the first variety, an oval or round bag is found, lying between the brain and the skull, quite unconnected with any of the surrounding parts, generally situated between or beneath the horns. They vary much in size, being sometimes no larger than a plum, at others as big as a goose's egg. They are filled with a clear fluid like water, sometimes intermixed with a thin cruor, when it is of a glutinous or slimy nature. Within, or in the skin of this bag are seen, according to Mr. Beattie, some little white bodies like nits. These are more particularly described by Mr. W. Hog in the following passage, which, although blended with some hypothetical notions, is highly creditable to his talent for accurate observation. "Two or three recent observations induce me to believe, that the dissolution of the brain,

&c. is occasioned by numbers of animalculæ, which I have observed swimming loosely in the liquor. They resemble ant's eggs, both in shape and colour, but are somewhat shorter. But as all the animals upon which I made the observation had been dead for some time, so these puny inhabitants of the brain were dead also; but if they had been living and organized animals, which I have no doubt they were, there would be multitudes of so diminutive a size as to be quite imperceptible to the naked eye; and I am fully convinced, that if the disease was minutely observed in all its stages by microscopical observation, that, whatever its beginning was, its progress would be, by the activity of these *animalculæ*, increasing both in number and size." In proportion as the disease advances, the bag increases in size, and by its pressure causes the brain to decrease, while the skull, immediately over the bag, becomes soft, and disappears, so that nothing intervenes between it and the integuments of the head. Sometimes, but only in those cases where no attempt has been made to cure it, there are many small bags, unconnected with each other, distributed through the brain.

Variety 2d. In the second variety the water is not contained in a bag, but within the substance of the brain, in certain cavities called its ventricles, and sometimes in the hinder parts, where it joins with the spinal marrow, in which case it is quite incurable.

Hard substances growing from the inside of the skull, or blows upon the head, occasionally produce all the symptoms of real *sturdy*, but in these cases no water is to be found.

Causes of Sturdy.—The cause of the symptoms is undoubtedly pressure on the brain, whether it arise from accidental contusion or a bony excrescence, as in false *sturdy*; or from a collection of water, as in the two legitimate varieties. What, however, gives rise to these collections of water is not so well ascertained. Inflammation of the brain probably precedes its effusion in the second variety; but the generation of the hydatids in the first is not at all understood. The disease is not contagious; neither is it peculiar to any soil. It generally affects hogs in the months of April, May, and June, and is commonly ascribed to exposure to tempestuous weather, without sufficient shelter; at least, in a well-sheltered flock few are affected by it, and a clothed sheep never. Some kinds of sheep are extremely predisposed to it, and will relapse again and again after having been cured; and horned sheep are specified by Mr. Singers as being most liable to it.

Cure of Sturdy.—The natural termination of this disease is invariably fatal, unless we except those rare recoveries which sometimes are the consequence of accidental blows in the head, probably rupturing the bag. Therefore, and more especially as the mutton in this disease is good, the sooner an attempt is made to relieve the animal by operation the better; and although it is extremely simple, and not unfrequently successful, thousands are suffered to perish through carelessness or ignorance. The cure may be attempted in three ways, by tapping, trepanning, or wiring.

1. *Tapping.*—"If the bag be seated any where in the crown of the head," says Mr. James Hog, "the gentlest way is to tap it in the place where the skull is soft, and let the water run out. This is commonly performed with an awl or large corking pin, although an instrument with a small tube in it (a small troca) might easily

be made, which would drain it off more completely. By this operation, if the instrument is not pushed too far, the animal is nothing the worse, whether it recover or not. But what is very remarkable, this plan is not successful on all farms alike, of which I have known many instances. There is an old shepherd on the farm of Mountberger, named William Cowan, whom I have often heard observe, that in a course of thirty years' experience, not one sheep out of twenty which he had tapped on his own farm had died, while it was very rare that he could cure any on some of the neighbouring farms. He performs it always with a corking pin." Mr. Laidlaw also says, that in his neighbourhood more have been cured by this operation than by any other; and he advises the sheep to be laid on its back, and the pin to be inserted obliquely; if water follow, the cure is certain, but even although it should not follow, provided the bag be pricked, it is often successful.

2. *Trepanning and Extraction.*—This has been so well and circumstantially described by Mr. Stevenson, that it is only necessary to transcribe what he has said of it.

"The animal being properly secured, and the head placed in the most convenient position, having the part to be cut uppermost, the skin is to be divided by an incision an inch and a half long, crossed by another of the same length, at right angles to it. The skull, which is quite soft, is now to be cautiously divided in the same manner, till the bag with the fluid appear clear at the bottom of the incision, which it commonly does. The soft skull is now to be turned back, or a bit cut out of it, so as to render the bag completely visible. It should be taken hold of by a pair of blunt forceps, and gently moved backwards and forwards, to loosen it from its connections,

nections, which are generally very slender. This may be also done by a crow-quill, or any blunt-pointed instrument, carried frequently round it.

"The nose of the animal is now to be held so as to restrain its breath, which forces the bag from its situation. The operator should continue moving and pulling it, stopping the breath at intervals, till it is quite extracted. The skin is then to be laid neatly down again, and a tarry cloth tied over the wound above the dry lint, which is folded and laid on it, to prevent either cold in spring, or flies in summer from injuring it. This should be allowed to remain for two days, when the dressings may be changed, and a bit of cloth spread with hogslard, fresh butter, or tar applied on the wound. The dressing should be changed every second day, for ten days or a fortnight; after which time, in ordinary cases, it will require no more attention, being generally healed up. The skull grows over it in about a month, and then becomes of its usual hardness; and the animal is equally healthy, as if no disease had previously existed.

"The senses, after the operation, return in a few hours, and next day they seem to be quite relieved.

"If by rashness or inattention the bag containing the fluid has been ruptured, which sometimes happens, it is very difficult, in many cases impossible, to extract the sac. The best practice in this situation of things is to place the animal in such a position as that all the fluid may run out. Wash the wound with spirits, and try to extract, if possible, the remains of the sac; then dress it with a mixture of *tar* and *basilicon*, or either separately, and turn the animal (which has now lost its stupid appearance) into good pasture. The damps and cold of night should be avoided, as they tend to produce inflammation, which very soon destroys the animal. In this case the admission of the external air, and the irritating dressings, make the sides of the sac adhere. This, however, is not always the case, as I have known after a week or two the symptoms return, after the alleviation which the operation always produced. When this happens, it is almost impossible to extract the bladder entire, on account of the inflammation from the cutting causing strong adhesion. In this case the bag may be opened, and a little spirits or port wine injected with a syringe, which I have known in more than one case prevent a return of the symptoms. This operation should not be performed in very warm weather, as maggots are extremely apt to breed in the wound. In frost inflammation is apt to be produced, which must also at that time render it improper. In these cases they should be fattened for the butcher as soon as possible."

There is a slight variation in the manner of performing this operation, noticed by Mr. James Hog, as practised by Mr. Laidlaw, of Willenslee. It consisted of burning a small hole through the soft part of the skull with a hot iron, and taking out the bag entire with a small hook; but Mr. Hog does not approve of it, as Mr. Laidlaw cured only about every fifth sheep on an average.

To this mode of operating is also to be referred the breaking off the horn under which the disease is supposed to lie, when no external softness is to be discovered.

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3. *Wiring.*—This remarkable operation is so accurately described by Mr. James Hog, that it will be only necessary to quote what he has said of it.

"But if the skull feel soft in the forehead, then the operation must be performed by thrusting a stiff sharpened wire up each nostril, until it stop against the upper part of the skull. If this cure were not well authenticated by daily observation, it might seem a very severe and dangerous operation, as the wire goes quite through the brain in two different places; yet a far greater number are cured by this way than any other. I have cured numbers both ways, and killed a part too; but those that I killed were generally with the wire, because if the other fails of the desired effect, the wire is always applied to as a last resource; and many have I seen cured by it, which were to all appearance quite past redemption.

"When I was a youth I was engaged for many years in herding a large parcel of lambs, whose bleating brought the whole sturdies of the neighbourhood to them, with which I was everlastingly plagued; but as I was frequently weaving stockings, I fell upon the following plan: I catched every sturdied sheep that I could lay my hands on, and probed them up through the brain and nostrils with one of my wires, when I beheld, with no small degree of pleasure, that by this simple operation I cured many a sheep to different owners; all which I kept to myself, having no authority to try my skill on any of them, and it was several years before I failed in one instance. If the sturdy is not at all to be felt by pressing with the thumbs, it is either seated in the centre of the brain or behind, and nothing can be done for them except with the wire. I have always observed, though I cannot well account for it, that on being wired a sheep is sick, in proportion to the stiffness of the gristle below the brain. If there is much resistance it is always very sick, but if the wire goes easily up it puts the sheep little off its ordinary. When one is wired it is proper to take hold of it with both hands, behind the ears, and shake its head loosely. This empties the bladder, and the water must find its way by the nose afterwards, for they will frequently grow quite better, though none be seen to issue from the nostrils at that time. It makes them sick for the present, but they are more apt to amend afterwards."

This singular operation is also preferred as the safest and most successful by Mr. W. Hog and Mr. Scott, who says, that after they are wired sheep will lie as if dead for hours, sometimes a whole day, and still recover.

TO BE CONTINUED IN OUR NEXT.

Electro-Chemical Researches on the Decomposition of the Earths; with Observations on the Metals obtained from the alkaline Earths, and on the Amalgam procured from Ammonia.

By HUMPHRY DAVY, *Esq. Sec. R. S. M. R. I. A.*

(Concluded from Page 132.)

V. *On the Production of an Amalgam from Ammonia, and on its Nature and Properties.*

IN the communication from Professor Berzelius and Dr. Pontin, which I have already referred to, a most curious and important experiment on the deoxydation and amalgamation of the compound basis of ammonia is mentioned, which these ingenious gentlemen regard as a strict proof of the idea I had formed of its being an oxyd with a binary basis.

Mercury, negatively electrified in the Voltaic circuit, is placed in contact with solution of ammonia. Under this agency it gradually increases in volume, and when expanded to four or five times its former dimensions becomes a soft solid.

And that this substance is composed of the deoxygenated compound basis of ammonia and mercury, they think is proved, 1, by the reproduction of quicksilver and ammonia with the absorption of oxygen, when it is exposed to air; and, 2, by its forming ammonia in water whilst hydrogen is evolved, and the quicksilver gradually becomes free.

An operation in which hydrogen and nitrogen exhibit metallic properties, or in which a metallic substance is apparently composed from its elements, cannot fail to fix the attention of chemists: and the peculiar interest which

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which it offered in its relations to the general theory of electro-chemical science, induced me to examine the circumstances connected with it minutely and extensively.

In repeating the process of the Swedish chemists, I found that to form an amalgam from fifty or sixty grains of mercury, in contact with saturated solution of ammonia, required a considerable time; and that this amalgam greatly changed even in the short period required for removing it from the solution.

I was, however, able, in this mode of operating, to witness all the results they have stated, and I soon found simple and more easy means of producing the effect, and circumstances under which it could be more distinctly analysed.

The experiments which I have detailed in the Bakerian Lecture for 1806 proved that ammonia is disengaged from the ammoniacal salts at the negative surface in the Voltaic circuit; and I concluded that, under this agency, it may be acted on in what is called the nascent state, when it was reasonable to conclude it would be more readily deoxygenated and combined with quicksilver.

On this view of the subject I made a cavity in a piece of muriate of ammonia; into this a globule of mercury, weighing about fifty grains, was introduced. The muriate was slightly moistened, so as to be rendered a conductor, and placed on a plate of platina, which was made positive in the circuit of the large battery. The quicksilver was made negative by means of a platina wire. The action of the quicksilver on the salt was immediate; a strong effervescence with much heat took place. The globule in a few minutes had enlarged to five times its former dimensions, and had the appearance of an amalgam of zinc; and metallic crystallisations shot from it, as a centre, round the body of the salt. They had an arborescent appearance, often became coloured at their points of contact with the muriate, and when the connection was broken rapidly disappeared, emitting ammoniacal fumes, and reproducing quicksilver.

When a piece of moistened carbonate of ammonia was used, the appearances were the same, and the amalgam was formed with equal rapidity. In this process of deoxydation, when the battery was in powerful action, a black matter formed in the cavity, which there is every reason to believe was carbonaceous matter from the decomposition of the carbonic acid of the carbonate *.

The strong attraction of potassium, sodium, and the metals of the alkaline earths for oxygen, induced me to examine whether their deoxydating powers could not be made to produce the effect of the amalgamation of ammonia, independently of the agency of electricity; and the result was very satisfactory.

When mercury, united to a small quantity of potassium, sodium, barium, or calcium, was made to act upon moistened muriate of ammonia, the amalgam rapidly increased to six or seven times its volume, and the compound seemed to contain much more ammoniacal basis than that procured by electrical powers.

As in these cases, however, a portion of the metal used for the deoxydation always remained in union in the

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* The black matter which separates at the negative surface in the electrical experiments on the decomposition of potash or soda, and which some experimenters have found it difficult to account for, is I find carbonaceous, and dependent upon the presence of carbonic acid in the alkali.

the compound; in describing the properties of the amalgam from ammonia, I shall speak only of that procured by electrical means.

The amalgam from ammonia, when formed at the temperature of 70° or 80°, is a soft solid, of the consistency of butter; at the freezing temperature it becomes firmer, and a crystallised mass, in which small facets appear, but having no perfectly defined form*. Its specific gravity is below 3, water being 1.

When exposed to air it soon becomes covered with a white crust, which proves to be carbonate of ammonia.

When thrown into water it produces a quantity of hydrogen equal to about half its bulk, and in consequence of this action the water becomes a weak solution of ammonia.

When it is confined in a given portion of air, the air enlarges considerably in volume, and the pure quicksilver re-appears. Ammoniacal gas, equal to one and a half, or one and three-fifths of the volume of the amalgam, is found to be produced, and a quantity of oxygen equal to one-seventh or one-eighth of the ammonia disappears †.

When thrown into muriatic acid gas it instantly becomes coated with muriate of ammonia, and a small quantity of hydrogen is disengaged.

In sulphuric acid it becomes coated with sulphate of ammonia and sulphur.

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* From the facet I suspect the form to be cubical. The amalgam of potassium crystallises in cubes as beautiful, and in some cases as large, as those of bismuth.

† This experiment confirms the opinions I have stated concerning the quantity of oxygen in ammonia; but as water is present, as will be immediately shewn, the data for proportions are not perfectly correct.

I attempted by a variety of modes to preserve this amalgam. I had hoped by submitting it to distillation out of the contact of air, or water, or bodies which could furnish oxygen, to be able to obtain the deoxygenated substance which had been united to the quicksilver in a pure form; but all the circumstances of the experiment opposed themselves to such a result.

It is well known to persons accustomed to barometrical experiments, that mercury after being once moistened, retains water with great perseverance, and can only be freed from it by boiling; and in the cases of the decomposition of ammonia, when a soft amalgam had been kept continually moist, both internally and externally for some time, it could not be expected that all the water adhering to it should be easily removed.

I wiped the amalgam as carefully as possible with bibulous paper; but even in this process a considerable portion of the ammonia was regenerated; I attempted to free it from moisture by passing it through fine linen, but a complete decomposition was effected, and nothing was obtained but pure quicksilver.

The whole quantity of the basis of ammonia combined in sixty grains of quicksilver, as is evident from the statements that have been made, does not exceed $\frac{1}{700}$ part of a grain, and to supply oxygen to this scarcely $\frac{1}{1000}$ part of a grain of water would be required, which is a quantity hardly appreciable, and which merely breathing upon the amalgam would be almost sufficient to communicate.

Hence, when an amalgam, which had been wiped by means of bibulous paper, was introduced into naphtha, it decomposed almost as rapidly as in the air, producing ammonia and hydrogen.

In oils it evolved hydrogen, and generated ammoniacal soap; and when it was introduced into a glass tube, closed by a cork, gas was rapidly formed, and the mercury remained free; and this gas, when examined, was found to consist of from about two-thirds to three-fourths ammonia, and the remainder hydrogen *.

That more moisture sometimes existed attached to the amalgam, when wiped as dry as possible by bibulous paper, than was sufficient for the effect of decomposition, I soon found by an experiment of distillation.

About a quarter of a cubic inch of an amalgam nearly solid was wiped very dry, and introduced into a small tube: in this tube it was heated till the gaseous matter had expelled the quicksilver; the tube was then closed, and suffered to cool, when moisture, which proved to be a saturated solution of ammonia, had precipitated upon it.

I have mentioned that the amalgams obtained from ammonia, by means of the metals of the fixed alkalies or alkaline earths, seemed to contain much more ammoniacal basis in combination than those procured by electricity: and when they are combined with the metals of the fixed alkalies or of the earths in any considerable quantities, they are much more permanent.

Triple compounds of this kind, when carefully wiped, scarcely produce any ammonia under naphtha, or oil, and may be preserved for a considerable time in closed glass tubes, a little hydrogen being the only product evolved from them.

I heated a triple amalgam obtained from ammonia by potassium, and which had been wiped by bibulous

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* In the experiment of the action of the amalgam upon air, the oxygen is probably absorbed by nascent hydrogen, and reproduces water, which is dissolved by the ammonia.

paper in a dry plate-glass tube over mercury; a considerable elevation of temperature was required before any gaseous matter was emitted, but the heat was raised till gas was rapidly formed, and the whole of the amalgam expelled from the tube: in cooling, the mercury rose very quickly in it, so that a great part of the gaseous matter had been either mercury or water, in vapour, or something which the mercury had absorbed in cooling. The small quantity which was permanent did not equal one-half the volume of the amalgam.

On the idea that this gas might be a compound of hydrogen and nitrogen in the state of deoxygenation, I mixed a small quantity of oxygen gas with it, but no change of volume took place; I then exposed it to naphtha, when one half of it was absorbed, which, by the effect the naphtha produced upon turmeric, must have been ammonia; the remaining gas analysed was found to consist of the oxygen that had been introduced, and of hydrogen and nitrogen to each other in the proportion of nearly four to one.

At first I was perplexed by this result, which seemed to prove the production of ammonia, independent of the presence of any substance which could furnish oxygen to it, and to shew that its amalgamation was merely owing to its being freed from water, and combined with hydrogen: but a satisfactory solution of the difficulty soon offered itself. Exposing the triple amalgam procured from ammonia by potassium to a concentrated solution of ammonia, I found that it had very little action upon it, and introducing the amalgam moistened by it into a glass tube, it had nearly the same permanency as the amalgam which had been wiped before it was introduced, a little hydrogen only being evolved; but on

heating

heating the tube, gaseous matter was rapidly generated, which proved to consist of two-thirds ammonia and one-third hydrogen.

In the instance in which the amalgam had been wiped, a small quantity of solution of ammonia, and perhaps of potash, must have adhered to it; and though the amalgam does not act upon this powerfully at common temperatures, yet when the water is raised in vapour it tends to oxygenate both the basis of ammonia and potassium, and hence hydrogen is evolved, and volatile alkali produced.

I distilled an amalgam procured by potassium from ammonia in a tube filled with the vapour of naphtha, and hermetically sealed, in the same manner as in the experiments for obtaining the metals of the earths, but in this case I procured ammonia, hydrogen, and nitrogen only, and pure mercury; and the residuum was potassium, which acted powerfully on the glass tube.

In another experiment of the same kind I kept one part of the tube cool by ice at the time the other part was strongly heated, but nothing condensible except mercury was produced, and the elastic products were the same as in the former instance.

I endeavoured to procure an amalgam from ammonia, to which no moisture could be supposed to adhere, by heating an amalgam of potassium in ammoniacal gas. The amalgam became covered with a film of potash, but it did not enlarge in its dimensions, and a considerable quantity of non-absorbable gas, which was found to consist of five parts of hydrogen, and one of nitrogen, was produced. The amalgam after this operation did not emit ammonia by exposure to air; hence it seems probable, that for the deoxygenation of ammonia, and the combination of its basis with mercury, the alkali must be in the nascent state, or at least in that condensed form in which it exists in ammoniacal salts, or solutions.

VI. *Some Considerations of general Theory, connected with the Metallization of the Alkalies and the Earths.*

The more the properties of the amalgam obtained from ammonia are considered, the more extraordinary do they appear.

Mercury by combination with about $\frac{1}{12000}$ part of its weight of new matter is rendered a solid, yet has its specific gravity diminished from 13.5 to less than 3, and it retains all its metallic characters; its colour, lustre, opacity, and conducting powers remaining unimpaired.

It is scarcely possible to conceive that a substance which forms with mercury so perfect an amalgam should not be metallic in its own nature *; and on this idea to assist the discussion concerning it, it may be conveniently termed ammonium.

But on what do the metallic properties of ammonium depend?

Are hydrogen and nitrogen both metals in the aëriform state, at the usual temperatures of the atmosphere,

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* The nature of the compounds of sulphur and phosphorus with mercury favours this opinion; these inflammable bodies by combination impair its metallic properties; cinnabar is a non-conductor, and it would seem, from Pelletier's experiments, Ann. de Chmie, vol. XIII. p. 125, that the phosphuret of mercury is not metallic in its characters; charcoal is a conductor, and in plumbago carbon approaches very near to a metal in its characters, so that the metallic nature of steel does not militate against the reasoning in the text. The only facts which I am acquainted with, that do militate against it, are the metallic characters of some of the sulphurets and phosphurets of the imperfect metals.

bodies

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bodies of the same character, as zinc and quicksilver would be in the heat of ignition?

Or are these gases in their common form oxyds, which become metallised by deoxydation?

Or are they simple bodies not metallic in their own nature, but capable of composing a metal in their deoxygenated, and an alkali in their oxygenated state?

These problems, the second of which was stated by Mr. Cavendish to me, and the last of which belongs to Mr. Berzelius, offer most important objects of investigation.

I have made some experiments in relation to them, but as yet unsuccessfully. I have heated the amalgam of potassium, in contact with both hydrogen and nitrogen, but without attaining their metallisation; but this fact cannot be considered as decisively for or against any one of these conjectures.

I mentioned in the Bakerian Lecture for 1807, that a modification of a phlogistic chemical theory might be defended on the idea that the metals and inflammable solids, usually called simple, were compounds of the same matter as that existing in hydrogen, with peculiar unknown bases, and that the oxyds, alkalies, and acids, were compounds of the same bases with water, and that the phænomena presented by the metals of the fixed alkalies might be explained on this hypothesis.

The same mode of reasoning may be applied to the facts of the metallisation of the earths and ammonia, and perhaps with rather stronger evidences in its favour, but still it will be less distinct and simple than the usually received theory of oxygenation, which I have applied to them.

The general facts of the combustion, and of the action of these new combustible substances upon water, are certainly most easily explained on the hypothesis of Lavoisier; and the only good arguments in favour of a common principle of inflammability, flow from some of the novel analogies in electro-chemical science.

Assuming the existence of hydrogen in the amalgam of ammonium, its presence in one metallic compound evidently leads to the suspicion of its combination in others. And in the electrical powers of the different species of matter, there are circumstances which extend the idea to combustible substances in general. Oxygen is the only body which can be supposed to be elementary, attracted by the positive surface in the electrical circuit, and all compound bodies, the nature of which is known, that are attracted by this surface, contain a considerable portion of oxygen. Hydrogen is the only matter attracted by the negative surface, which can be considered as acting the opposite part to oxygen; may not the different inflammable bodies, supposed to be simple, contain this as a common element?

Should future experiments prove the truth of this hypothesis, still the alkalies, the earths, and the metallic oxyds will belong to the same class of bodies. From platina to potassium there is a regular order of gradation as to their physical and chemical properties, and this would probably extend to ammonium, could it be obtained in the fixed form. Platina and gold in specific gravity, degree of oxydability, and other qualities, differ more than arsenic, iron, and tin, than these last do from barium and strontium. The phænomena of combustion of all the oxydable metals are precisely analogous. In the same manner as arsenic forms an acid by burning in air, potassium forms an alkali and calcium an earth;

in a manner similar to that in which osmium forms a volatile and acrid substance by the absorption of oxygen, does the amalgam of ammonium produce the volatile alkali; and if we suppose that ammonia is metallised, by being combined with hydrogen, and freed from water, the same reasoning will likewise apply to the other metals, with this difference, that the adherence of their phlogiston or hydrogen would be exactly in the inverse ratio of their attraction for oxygen. In platina * it would be combined with the greatest energy; in ammonium with the least; and if it be separable from any of the metals without the aid of a new combination, we may expect that this result will be afforded by the most volatile and oxydable, such as arsenic, or the metals of the fixed alkalies, submitted to intense heat, under electrical polarities, and having the pressure of the atmosphere removed.

Whatever new lights new discoveries may throw upon this subject, still the facts that have been advanced shew that a step nearer at least has been attained towards the

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* The common metallic oxyds are lighter than their bases, but potash and soda are heavier; this fact may be explained on either theory; the density of a compound will be proportional to the attraction of its parts. Platina, having a weak affinity for oxygen, cannot be supposed to condense it in the same degree as potassium does; or if platina and potassium be both compounds of hydrogen, the hydrogen must be attracted in platina, with an energy infinitely greater than in potassium. Sulphuric acid is lighter than sulphur; but phosphoric acid (where there is a stronger affinity) is heavier than phosphorus. The oxyd of tin (wood tin) is very little inferior to tin in specific gravity. In this instance the metallic base is comparatively light, and the attraction for oxygen strong; and in a case when the metal is much lighter, and the attraction for oxygen stronger, it might be expected *à priori* that the oxyd be heavier than the base.

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the true knowledge of the nature of the alkalies and the earths *.

Something

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* Since the facts in this Paper were communicated to the Royal Society, I have seen an account of some very curious experiments of MM. Gay Lussac and Thenard, (in Number 148 of the Moniteur, for 1808, which I have just received,) from one of which they have concluded, "that potassium may be a compound of hydrogen and potash."

These gentlemen are said to have heated potassium in ammonia, and found that the ammonia was absorbed, and that hydrogen gas equal to two-thirds of its volume appeared, and that the potassium by this process had become of a grayish-green colour. By heating this grayish-green substance considerably, two-fifths of the ammonia were again emitted, with a quantity of hydrogen and nitrogen corresponding to one-fifth more, and by adding water to the mixture, and heating it very strongly again, they obtained the remainder of the ammonia, and nothing but potash was left.

In these complex processes, the phænomena may be as easily explained on the idea of potassium being a simple, as that of its being a compound substance; nor when the facts that have been stated in this paper, and those about to be stated, are considered, can the view of these distinguished chemists, as detailed in the notice referred to, be at all admitted.

Potash, as I have found by numerous experiments, has no affinity for ammonia, for it does not absorb it when heated in it; it is not, therefore, (allowing their theory,) possible to conceive that a substance having no attraction for potash, should repel from it a substance which is intimately combined with it, and which can be separated in no other way.

A part of the hydrogen evolved in their experiment may be furnished by water contained in the ammonia; but it is scarcely possible that the whole of it can be derived from this source, for on such an idea the ammonia must contain more than half its weight of water. There is, however, no evidence that the whole of the hydrogen may not be furnished by the decomposition of the volatile alkali itself. Potassium in its first degree of oxygenation may have an affinity for nitrogen, or potassium may expel a portion of hydrogen at-

Something has been separated from them which adds to their weight; and whether it be considered as oxygen

or

at the moment of its combination with ammonium; and as the whole of the ammonia cannot be regenerated without the presence of water; hydrogen and a little oxygen may be furnished to the remaining elements of the ammonia, from the water, and oxygen to the potassium.

Even before the conclusion was formed, that a metallic substance is decomposed in this experiment, it should have been proved that the nitrogen had not been altered.

That mere potash, combined with hydrogen, cannot form potassium, is, I think, shewn by an experiment which I tried, in consequence of the important fact lately ascertained by MM. Gay Lussac and Thenard, of the deoxydation of potash by iron.

An ounce of potash was kept in ignition for some time in an iron tube, ground into a gun-barrel, in which one ounce and a half of iron-turnings were ignited to whiteness; a communication was opened, by withdrawing a wire which closed the tube containing the potash, between that alkali and the metal.

As the potash came in contact with the iron, gaseous matter was developed, which was received in a proper apparatus, and though some of it was lost by passing through the potash into the atmosphere, yet nearly half a cubic foot was preserved, which proved to be hydrogen. In the tube were found two products, one in the quantity of a few grains, containing potassium, combined with a small quantity of iron, and which had sublimed in the operation, and the other a fixed white metallic substance, which consisted of an alloy of iron and potassium.

The first of these substances burnt when thrown upon water, and in its other characters resembled pure potassium, except that its specific gravity was greater, its colour less brilliant; and when it tarnished in the atmosphere it became of a much deeper colour than pure potassium.

Now potash that has been ignited is the purest form known of this alkali; but on MM. Gay Lussac's and Thenard's theory, this potash must contain water, not only sufficient to furnish hydrogen to metallise the alkali, but likewise the quantity disengaged: dry potash

then,

or as water, the inflammable body is less compounded than the uninflammable substance resulting from its combustion.

Other

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then, as it is procured in our experiments, must on this theory be a compound, containing a considerable quantity of matter which can furnish hydrogen; and what would be its form or properties if deprived of this matter we are wholly unable to judge, which brings this question to the general question discussed in the text.

Potassium I find may be produced readily from dry ignited potash in electrical experiments; and the result of the combustion of potassium in oxygen gas is an alkali so dry that it produces violent heat, and ebullition when water is added to it.

In MM. Gay Lussac's and Theuard's experiment on the action of potassium on ammonia, the hydrogen disengaged in the first process, and that existing in the ammonia disengaged in the second process, exactly equals the whole quantity contained in the ammonia. But there is no proof of any hydrogen being disengaged from the potassium, for the ammonia lost is not generated, nor potash formed, but by the addition of a substance, consisting of oxygen and hydrogen; and as the three bodies concerned in this experiment are potassium, ammonia, and water, the result ought to be potash, ammonia, and a quantity of hydrogen, equal to that evolved by the mere action of water on potassium, which is said to be the case.

Even if there were no other proofs, the chemical properties of potassium are so wholly unlike those that might be expected from a compound of potash and hydrogen, that they are almost sufficient to decide the question. Potassium acts upon water with much more energy than potash, and produces much more heat in it; and yet if a compound of hydrogen, the affinity of potash for water must be diminished by its affinity for hydrogen, to say nothing of the quantity of heat which ought (on the common theory of capacity for heat) to be carried off by this light inflammable gas.

Potassium burns in carbonic acid, and precipitates charcoal from it; whereas hydrogen electrised with carbonic acid converts it into gaseous oxyd of carbon.

Potash has a very slight attraction for phosphorus; but potassium has a very strong affinity for it, so as to separate it from hydrogen, and according to MM. Gay Lussac and Thenard, with the phænomena

of

Other hypotheses might be formed upon the new electro-chemical facts, in which still fewer elements than those allowed in the antiphlogistic or phlogistic theory might be maintained. Certain electrical states always coincide with certain chemical states of bodies. Thus acids are uniformly negative, alkalies positive, and inflammable substances highly positive; and as I have found, acid matters when positively electrified, and alkaline matters when negatively electrified, seem to lose all their peculiar properties and powers of combination. In these instances the chemical qualities are shewn to depend upon the electrical powers; and it is not impossible that matter of the same kind, possessed of different electrical powers, may exhibit different chemical forms *.

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of inflammation. Potash has no affinity for arsenic, yet from the experiments of these gentlemen it appears that potassium separates arsenic from arseniated hydrogen; and hydrogen, which is supposed by them to exist in both compounds, can have no affinity for hydrogen, nor can hydrogen in one form be supposed capable of separating arsenic from hydrogen in another form.

Could not the experiment of MM. Gay Lussac and Thenard be explained except on the supposition of the hydrogen being derived from the potassium, it would be a distinct fact in favour of the revival of the theory of phlogiston. It would not prove, however, that potassium is composed of hydrogen and potash, but that it is composed of hydrogen and an unknown basis; and that potash is this basis united to water.

* Phil. Trans. 1807, Part I, p. 23. The amalgam obtained from ammonia offers difficulties to both the phlogistic and antiphlogistic hypotheses. If we assume the phlogistic hypothesis, then we must assume that nitrogen, by combining with one-fourth of its weight of hydrogen can form an alkali, and by combining with one-twelfth more, can become metallic. If we reason on the antiphlogistic hypothesis, we must assert, that though nitrogen has a weaker affinity

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I venture to hint at these notions: but I do not attach much importance to them; the age of chemistry is not yet sufficiently mature for such discussions; the more subtle powers of matter are but just beginning to be considered; and all general views concern-

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for oxygen than hydrogen, yet a compound of hydrogen and nitrogen is capable of decomposing water.

The first assumption is, however, by far the most contradictory to the order of common chemical facts; the last, though it cannot be wholly removed, is yet lessened by analogies. Thus alloys in general, and inflammable compounds, are more oxydable than the simple substances that compose them. Sulphuret of iron at common temperatures decomposes water with facility, whereas sulphur under the same circumstances has no action on water, and iron a very small one. The compound of phosphorus and hydrogen is more inflammable than either of its constituents.

Should a new theory of the dependence of the chemical forms of matter upon electrical powers be established, the facts belonging to ammonium would admit of a more easy solution. Ammonium might be supposed to be a simple body, which by combining with different quantities of water, and in different states of electricity, formed nitrogen, ammonia, atmospherical air, nitrous oxyd, nitrous gas, and nitric acid.

Water, on this idea, must be supposed a constituent part of all the different gases; but its electricities in oxygen and hydrogen would probably be the very reverse of what they have been supposed by M. Ritter, and some ingenious English enquirers.

Water positively electrified would be hydrogen; water negatively electrified oxygen: and as in the physical experiments of temperature, ice, added to certain quantities of steam by an equilibrium of heat, produces water, so in the chemical experiment of the generation of water the positive and negative electricity of oxygen and hydrogen in certain proportions would annihilate each other, and water alone be the result. At all events ammonium, whether simple or compound, must be considered as owing its attraction for oxygen to its highly positive electrical state, which is shewn by its powerful determination to the negative surface in the Voltaic circuit.

ing them, must as yet rest upon feeble and imperfect foundations.

Whatever be the fate of the speculative part of the enquiry, the facts however will, I hope, admit of many applications, and explain some phænomena in nature.

The metals of the earths cannot exist at the surface of the globe; but it is very possible that they may form a part of the interior; and such an assumption would offer a theory for the phænomena of volcanoes, the formation of lavas, and the excitement and effects of subterraneous heat *, and would probably lead to a general hypothesis in geology.

The luminous appearance of those meteors connected with the fall of stones, is one of the extraordinary circumstances of these wonderful phænomena. This effect may be accounted for, by supposing that the substances which fall come into our atmosphere in a metallic state; and that the earths they principally consist of are a result of combustion; but this idea has not the slightest connection with their origin or causes.

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* Let it be assumed that the metals of the earths and alkalies, in alloy with common metals, exist in large quantities beneath the surface, then their accidental exposure to the action of air and water must produce the effect of subterranean fire, and a product of earthy and stony matter analogous to lavas.

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List of Patents for Inventions, &c.

(Continued from Page 144.)

John Schmidt, of Saint Mary Axe, London, Watchmaker; for a phantasmagoric chronometer, or nocturnal dial, representing, or making visible at night, to an enlarged size, the dial of a watch against the wall of a room; the reflection obtained by a light and optical apparatus being at the same time sufficient to give the room a pleasing illumination: the nocturnal dial may with little alteration be constructed of any watch or time-piece: but to render the whole as simple and useful as possible, he has also invented a mechanism or instrument which is applicable to, or separately useful from, the above, on account of its peculiar action, which he calls *The Mysterious Circulator*, or *Chronological Equilibrium*: this equilibrium requiring only one hand or nonius to shew seconds, minutes, and hours, and is particularly useful, and may (if required, with little alteration) represent an orrery. Dated December 20, 1808. Specification to be enrolled within one month.

John Frederick Archbold, of Great Charlotte-street, Blackfriars-road, in the county of Surrey; for improvements in making brandy; comprising, first, a new method in making ~~wine, as the~~ worts or must for the making the brandy, and a still applicable to the working off the same; and a new method of rectifying the spirit when worked off. Dated December 20, 1808. Specification to be enrolled within six months.

WILLIAM TOMPSON, of Deritend, in the parish of Aston, near Birmingham, in the county of Warwick, Locksmith; for a new-invented lock, which acts in a perpendicular, and then in a horizontal direction, with springs and tumblers, one part being at liberty whilst the other is in motion, the bolts of which lock return into the body thereof when it is unlocked. Dated December 29, 1808. Specification to be enrolled within one month.

MALCOLM M'GEORGE, of Bell-yard, Carey-street, in the county of Middlesex, Musical Instrument-maker, and WILLIAM M'FARLAND, of the Strand, in the county of Middlesex, Umbrella-manufacturer; for certain improvements in the construction of umbrellas and parasols. Dated December 29, 1808. Specification to be enrolled within one month.

WILLIAM STEEL, of Liverpool, in the county of Lancaster, Glass-dealer; for an entire new machine, engine, or instrument, for making white salt, which will be much more useful and advantageous to the public than any machine, engine, or instrument, hitherto invented for that purpose. Dated December 29, 1808. Specification to be enrolled within one month.

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THE

REPERTORY

OF

ARTS, MANUFACTURES,

AND

AGRICULTURE.

No. LXXXII. SECOND SERIES. March 1809.

Specification of the Patent granted to WILLIAM SHOTWELL, *of the City of New York, in North America, late residing in the Parish of Saint Mary Lambeth, in the County of Surrey, and now of the City of York, in that Part of the United Kingdom called England; for certain Improvements in the manufacturing Mustard. Communicated to him by a Foreigner.*

Dated June 14, 1808.

TO all to whom these presents shall come, &c. NOW KNOW YE, that in compliance with the said proviso, I the said William Shotwell do hereby declare that the said invention is described in manner following; that is to say: I take mustard-bran, or the offal of mustard, after as much mustard-flour has been taken out as is done by any of the modes now or hereafter used. I wet this bran or offal with water, then grind it between horizontal stones, or triturate it any other way, at pleasure;

after which I immerse this in a considerable quantity of water, stirring it well; then I suffer the bran, which is the most ponderous, to subside. When this is done, and whilst the flour is yet suspended, I draw off all that is above the bran into a flannel, or other suitable strainer, placed over a vat, which vat is to have a luch at its bottom. This strainer serves to filter the mustard, and prevents any particles of bran, or other foreign substance, from passing into the vat. In this vat I suffer the mustard-flour to precipitate. I then draw off the water from above the flour as close as possible: when this is done I draw off all I can from below the luch, making use of the same water for succeeding parcels as often as it is found to answer. My mustard now being of the consistency wished, I preserve it in the common mode. The bran left in the first vessel will still contain a considerable portion of flour, and should have a second water put to it, then be well stirred, and suffered to settle, and should undergo the same processes as last, or the water, whilst the flour is suspended in it, may serve to wet a second parcel of bran. I have varied the mode of separating the flour from the bran, but have found none so simple and effectual as the above. During the above processes I endeavour to keep the air from the mustard, and to complete the operations as speedily as possible, to prevent the pungency from escaping.

To make dry mustard from bran, after as much mustard-flour has been taken from it as is done by any of the modes now or hereafter used, I take the coles of India corn, break them small, mix them with mustard-bran, grind it in a corn-mill, or comminute it in any other way. I then sift it, and afterwards repeat these processes

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processes as often as I find it profitable. I have used a great variety of other substances to mix with the bran. I have likewise taken wheat-flour, or at pleasure other appropriate substances, and mixed this with mustard-bran, previously worked as above, which I have comminuted, and sifted as often as I have found it advantageous. I have sometimes taken these products, mixed them with fresh bran, and worked this mixture in the aforesaid manner. The product now obtained, possesses a considerable degree of pungency. I have taken fresh flour, or other appropriate substance, and mixed with this last bran, then operated on it as before: this latter product I have passed through fresh bran in the same way, when it will have acquired a considerable degree of pungency. The quantity of flour, or other appropriate substance to be used, must be in proportion to the richness of the bran, and can only be ascertained by a little observation. I have also taken white mustard-flour, meal, or bran, and worked it with brown mustard-bran in the same way, and have found the product possessing a considerable portion of the pungency of the brown. I have also put among the bran small portions of flour, or other appropriate ingredients, previous to comminution and sifting, and so repeatedly added flour, &c. for a number of times, generally working the bran over after I have done adding flour or other appropriate ingredients once or oftener.

I have also adopted a more simple and expeditious mode of sifting mustard. I prepare a frame, about six and a half feet in length, twenty-six inches in width, and five inches deep, into which I fix another frame or frames with silk bottom or bottoms. This frame is suspended with one end a little higher than the other, and under it is fixed a chest: from about the middle of each of the sides of this frame projects a piece of iron or wood, about fourteen inches from the side, which is to run between two upright pieces. These projections are intended to keep the sieve-frame steady in its motion backwards and forwards, it being propelled with sufficient velocity to cause the meal to have sufficient motion on the bottom of the sieve. On each side of the sieve is placed mallets or hammers, having handles that spring, which the sieve-frame is intended to strike against. I then prepare a hopper, generally similar to those used in corn-mills, having a shoe under it, which is so contrived, that by the motion of the sieve it has sufficient motion to deliver down its contents, which hopper is fixed over the highest end of the sieve. I have sometimes annexed to the upper end of the sieve a box, open at top, to receive the meal, and having a hole at bottom, so as to let the meal pass from it to the sieve. This hole is contracted or enlarged by means of a slide. I have had a hopper placed above the sieve, with a conductor of cloth or leather affixed to the bottom of the hopper, having the lower end of it to touch the sieve, and having a string round its mouth to contract it. The motion of the sieve causes the conductor to deliver the meal into it. The bran is to pass through the lower end of the sieve into an apartment separate from the flour. The improvement of supplying the sieve by means of the above, or any other kind of hopper, is what I claim as a new improvement on sifting. The sieve should be so hung that it may conveniently be brushed under the bottom, or brushes may be fixed the length of the sieve, to be moved by crank, by machinery, or any other way at pleasure, which I also claim as an improvement.

The peculiar advantages arising from the above improvements are the following. In the first place, I obtain a considerable quantity of genuine mustard, by a simple and easy process, from the bran or offal, which is deemed to be of but little value. In the second place, I obtain an article possessing a considerable degree of the pungency of the brown mustard-seed at a small expense, which may either be used in the state thus procured, or be mixed with genuine mustard. In the third place, by connecting a hopper or other apparatus with the upper end of the sieve, the labour of supplying the sieve with meal is very much lessened, and the supply is more regular than when done by hand, and by fixing long brushes under the sieve, to be moved by crank or otherwise, the labour of brushing is lessened.

In witness whereof, &c.

Specification of the Patent granted to Edward Dampier, *of Primrose-street, in the City of London, Manufacturer; for certain Machinery for rasping, grating, or reducing into small Parts or Powder, such Woods, Drugs, and other Substances, for the Use of Dyers and others, as are not easily to be pulverized by mere Percussion.* Dated March 12, 1806.

With a Plate.

To all to whom these presents shall come, &c. Now know ye, that in compliance with the said proviso, I the said Edward Dampier do hereby declare that the nature of my said invention, and in what manner the same is to be carried into effect and practice, are described in manner following; that is to say: I construct a large wheel or flat surface, of iron or other metal, or of any other fit material, for the purposes hereinafter mentioned, and affix the same to a vertical shaft or arbor, which is driven round by the machinery and powers commonly used for manufacturing works. Upon the face of the wheel I attach, by screws, keys, bolts, or any other well-known means, certain cutters or raspers, having their edges or faces toothed and directed upwards; each of which is fixed so that its length shall be directed towards the shaft, either precisely, or with such an obliquity, as that the line, of the length of each rasper, shall every where cross the circles described by the motion of its teeth, and close to each cutter or rasper there is a perforation, or long hole, quite through the face of the wheel, for the purpose of permitting the rasped wood or other material to fall through. In the use and application of this machinery the pieces of wood, drugs, or other substances intended to be rasped, grated, or reduced into small parts, or powder, are placed and secured upon the face of the said wheel, which by its rotation causes the teeth of the cutters to act upon the same, and to cut off portions or raspings of the same, which fall through into a proper receptacle.

And I do farther declare, that the face of the said wheel may be made bevelling inwards or outwards, and will admit of various forms, dimensions, and velocities of motion; and also, that, by contrivances well known to workmen, it is easily practicable either to fix all the

cutters

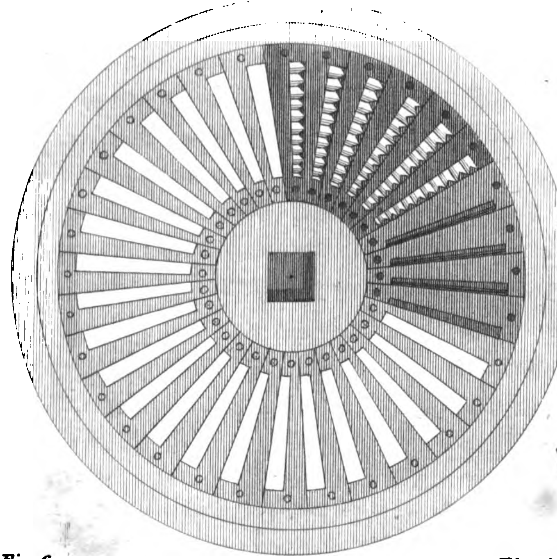


Fig. 1.

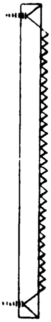


Fig. 6.

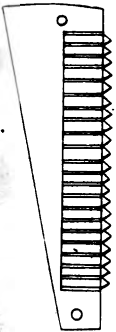


Fig. 4.

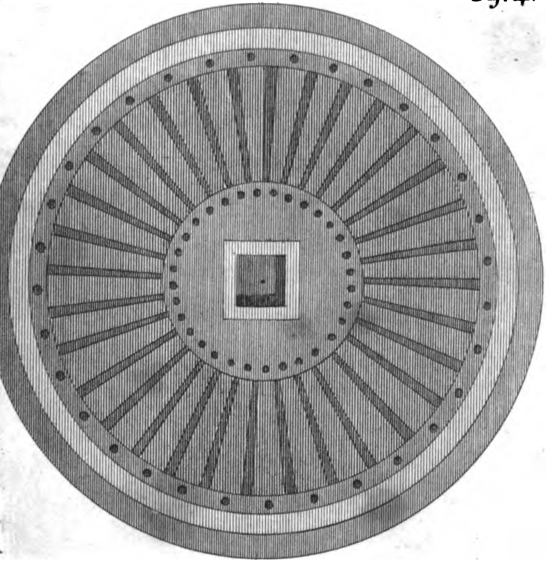


Fig. 3.

Fig. 5.

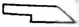
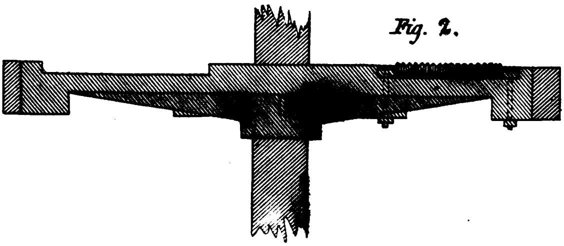


Fig. 2.



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cutters upon the wheel at once, and fasten them there by one key, or mode of connection, or otherwise, that each cutter may be separately attached, and taken out, when needful, independently of the others.

The annexed drawings indicate one of the constructions of the said machinery, in which the face of the wheel is flat, and the cutters placed in the radical direction.

Figs. 1, 2, and 3 (Plate VIII.) represent a large cast-iron wheel or plate.

Fig. 5 shews the end view or section of one of the cutters or raspers.

Fig. 4 represents the same, viewed by looking downwards, and Fig. 6 represents the same viewed in front.

The dark-shaded parts of Fig. 1 shew six of the cutters or raspers bolted or screwed in their respective places; and when the wheel is completely fitted up its whole face is thus supplied.

Fig. 3 shews the under part of the wheel, and Fig. 2, being the section thereof, shews the manner in which the cutters or raspers may be lodged and fixed in their places, although the same may be fixed by any other proper means, as hath been already observed.

In witness whereof, &c.

Specification of the Patent granted to DAVID THOMAS, *of Featherstone-buildings, in the County of Middlesex, Gentleman; for a perforated Vessel, Percolator, and Frame, for making or preparing Potable Coffee.*

Dated May 30, 1808.

TO all to whom these presents shall come, &c. NOW KNOW YE, that in compliance with the said proviso, He the said David Thomas doth by this present instrument in writing under his hand and seal declare that the nature of his said invention, and in what manner the same is to be performed, is particularly described and ascertained in manner following; that is to say: The said invention consists of a perforated urn (or vessel of various forms), a percolator, and a frame, which may be used collectively in a portable form, or separately if that form should not be preferred.

The principal part of the machine is an urn (or vessel furnished with a cock for drawing off its contents), rendered effective by the means hereafter described.

This urn is the receiver or receptacle of the beverage which is prepared from the material coffee, by means of hot or boiling water made to pass through it. The contents of the receiver will therefore be in a potable state.

In order to render this urn effective, since filtration into a close vessel would soon be impeded and stopped by the compressed air, a number of small perforations or flues are made in the upper part of the urn. These are calculated to release the confined and rarified air, being open while the percolation is going on, and so contrived, that they are covered at the same time and with the same cover as the large aperture or mouth of the urn, upon the removal of the percolator. By these means the urn becomes a close vessel when the percolation is completed, from which neither the finer qualities or essence of the coffee, nor its heat, can escape by evaporation.

The next part of the invention is the percolator or small box, which contains and confines the material coffee (in its ground or pulverized state) within itself, and prevents its rising and mingling with the water when poured into the cylinder.

The percolator may be united to, or detached from, a cylinder or barrel that receives the water, as occasions may require. The percolator (with its contents) becomes the medium through which the water passes into the urn, where it assumes the character of potable coffee. This appendage (the percolator) is furnished with a cover (pierced throughout with very small holes), which is fitted to it, either independently of the cylinder, or fixed to the latter in that part which is contiguous to the percolator. In either case its office is the same, namely, to confine the coffee, so as to prevent any portion of the water from passing into the receiver but through the whole mass. The bottom of the percolator is pierced or bored in the same way as its cover. The cylinder above-mentioned is a tube superadded to the urn and percolator, and it may be regarded as a part of the latter. This hollow vessel may be constructed in a prismatic or in a cylindrical form; the latter, as it conforms to the present shape of the percolator, has been preferred.

The frame or stand is calculated to elevate and support, at a proper height for drawing off its contents, a vessel discharged by means of a cock, when not constructed in the common form of urns, whether adapted to this or any other purpose. It serves also to inclose the vessel and its appendages, when they are made in the portable form, and to protect them from injury. It is calculated besides for being occasionally fixed to the table or plane upon which it is placed, and for the reception of a lamp.

The Patentee reserves to himself the exclusive right of modifying and varying the application of these principles, inventions, and improvements, according to circumstances, in such manner as may best suit the form of the vessel or its appendages, as well in respect to the flues or perforations as to the percolator and frame, whether affecting their respective forms or situation. In witness whereof, &c.

OBSERVATIONS BY THE PATENTEE.

As the portable form of the machine is altogether peculiar to this invention, and remarkable for its compactness, elegance, and convenience, the Patentee has communicated the following more particular account of it, which may serve also to elucidate the general application.

In this form it is called the coffee canteen, in order to distinguish it from other forms of the urn or receiver (whose structure may render a frame or stand unnecessary), in which variety and decoration, suitable to the table, are preferred to that precision and uniformity which are best adapted to travelling purposes.

The coffee canteen is of a perfectly cylindrical form, separable into the following parts:

No. 1, a receiver or urn, being a cylindrical vessel with a cover, &c.

No. 2, a cylinder or barrel fitted to the inside of No. 1.

No. 3, a percolator or charger fitted to No. 2.

No. 4, a case or stand for inclosing the whole, and for supporting the canteen when in use.

The receiver, No. 1, has two necessary appendages (Nos. 2 and 3, which are reposited within itself, when not in immediate use, without increasing the bulk in any degree), namely, the percolator, and the cylinder to which it is attached.

Each of these three parts, the receiver, the percolator, and the cylinder, has a use distinct from the others.

The cylinder receives the water, which passes through it pure and uncontaminated, leaving it perfectly clean.

The percolator contains and confines the material coffee, or medium, through which the water passes from the cylinder into the receiver.

This article (the percolator) being the most essential part of the machine, in its effect, it is desirable to give the most perfect idea of its form and use. It may aptly be represented by a plain snuff-box of a large size, perforated at the top and bottom, with very small holes, and occasionally united to the end of a tube (being the cylinder which receives the water). The most approved method of uniting these is, by previously fixing the cover of the box to the tube or cylinder, making it a part thereof, and then screwing the box into the cover so fixed, or by screwing the box itself in that manner, leaving the cover at liberty, but closely fitted to the box.

The whole body of water passes through the coffee, contained in the percolator, into the receiver, as through a filtering stone, before it can possibly escape. Hence it is obvious, that every small portion of the fluid passes successively through the mass of coffee, without raising the latter to its surface and leaving it adhering to the sides of the vessel, while it passes partially through the remainder; and yet the material coffee has ample room to expand itself, and to be saturated with the fluid.

The receiver then contains the whole of the beverage, the percolator the lees or grounds, and the cylinder becomes empty, dry, and perfectly clean.

This process may be repeated as often as occasion requires, simply by re-filling the percolator, or by displacing it by another, and so on alternately; the cylinder, as before observed, remaining clean. In the mean time, and while the new process is going on, the previous preparation may be drawn off.

The clumsiness of pouring off the beverage by means of a lip or spout at the brim, which in sizeable vessels is extremely inconvenient, is obviated by drawing it off through a small urn cock, and the necessity of the above mode, and others equally awkward and objectionable, though heretofore indispensable, (because without an opening the filtration could not be effected, in consequence of the air being confined, and at the same time rarified in the receiver, so as to resist the gravitating fluid,) is herein removed by a few small perforations surrounding the base of the cylinder.

The principle of the frame or stand, shewing its application to two useful purposes (expressed by those terms), having been already specified, it is unnecessary to expatiate upon the subject, since the principle embraces different modes of effecting this double application; yet as the object of these observations is, the most perfect elucidation, and the mode hitherto preferred is perfectly novel and unique, not increasing the bulk in any sensible degree, it may not be improper to give a brief explanation. The change from a cylindrical frame or case to a stand is produced, simply, by depressing its upper end or cover, and this is effected by means of four pins projecting from the edge of the cover, and sliding through perpendicular grooves, cut about half way down the inside of the cylindrical frame, at the termination of which they rest, thereby forming a stand for the urn at a convenient height.

To prevent this end or cover from sliding off, when the canteen is inclosed, the above grooves, instead of being open from their bottom to the top of the frame, open into a horizontal groove near the top. In this the cover freely circulates, and it is extricated from the frame by means of intermediate openings, or notches, cut from the upper side of the horizontal groove. Hence it is obvious, that the cover can neither be raised nor depressed but at certain points of this groove.

If the receiver be made of silver, plated metal, or the like, it will be fortified against injury by this frame; which, instead of concealing, heightens its beauty by a rich contrast, being made of burnished or gilt brass.

A lamp may be used at pleasure fitted to the frame under the receiver.

At sea, or in aquatic excursions, a screw-bolt may be introduced through an aperture in the centre of the stand, and a nut screwed on, by which means it is effectually secured to a table, locker, &c.

The object of occupying a small space when not in immediate use, so as to adapt it to the use of ships and camps and all travelling purposes, has, in the construction, been constantly sought and completely attained;

for the machine when consolidated (including a caddy for ingredients) is contained in one of its parts, which does not fill the crown of a small hat. And, when it is considered that the whole apparatus adapted to every use for which it can be required, and answering every purpose that could be aimed at, may be inclosed in a hollow cylinder, six inches and a half in height, and four inches and a half in diameter; it may safely be pronounced an unrivalled model of precision, utility, and elegance.

To the curious it will not appear an uninteresting fact, that the construction and process, simple as they are made to appear, are founded upon pure philosophical principles, in which chemistry, pneumatics, and hydrostatics, have some share; and that without due regard to these, the machine would be ineffective.

Improved Mode of constructing Muffles for Chemical Purposes. By Mr. EDMUND TURRELL.

With a Plate.

From the TRANSACTIONS of the SOCIETY for the Encouragement of ARTS, MANUFACTURES, and COMMERCE.

HAVING experienced much inconvenience in the common mode of moulding muffles on wooden blocks, for the use of chemists, enamellers, &c. I beg leave to lay before your praise-worthy Society, an improved method, possessing the following advantages: namely,

First. By this new method of moulding muffles, coarser and cheaper materials may be used than can be employed in the common mode; and which also gives them the valuable property of resisting a greater degree of heat.

Secondly. That much time will be saved by this improved

proved method of manufacturing them, must be allowed, when the two modes are compared.

Thirdly. The certainty of making them without cracks or flaws, and with coarser materials, will appear obvious, when it is considered, that by this improved method, they are *internally* moulded instead of *externally*; by which means the strength of the operator may have its full effect, in firmly compressing the composition into the mould; Whereas, in the old mode, the workman, after having spread the composition upon a cloth, guessing at its thickness, bends it over the block in the best way he can, and by thus disturbing the composition, he must needs make many cracks and flaws, which can be but imperfectly closed in smoothing the surface of the muffle, whilst upon the block; the evil consequence attending which is, its being subject to fly or crack when exposed to a great heat; and it will also be plainly seen, that, in the old mode, a great disadvantage is felt by the sides of the muffle, whilst in its wet state, hanging from its centre, and which also tends to crack it, as there can be nothing applied to assist it in this case, but by employing a greater proportion of cohesive clay in the composition, which, however, produces little if any advantage; whereas in the mode which I have invented, this fault is entirely obviated, and the composition, by its contraction in drying, assists the extrication of the muffle from the mould.

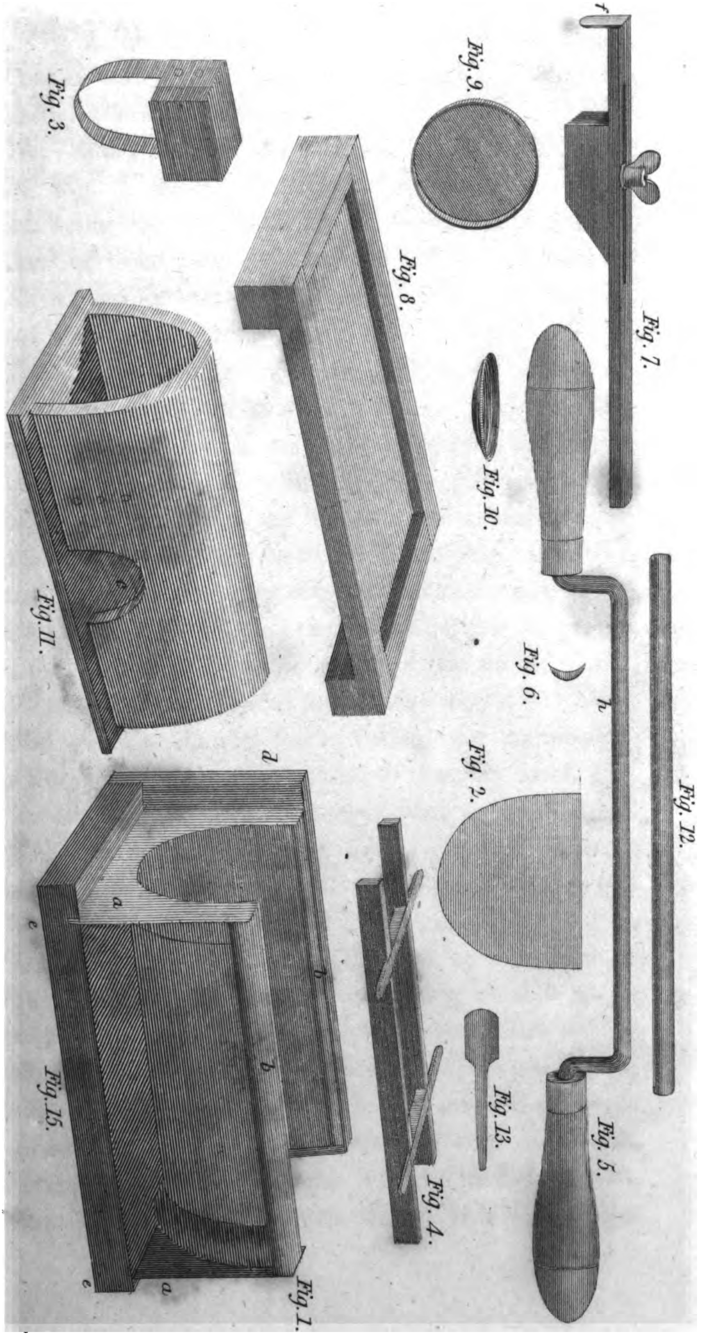
Fourthly. With respect to simplicity, this new mode will be found to possess a very great advantage, for a boy of twelve years of age may be taught to make them in a very short time.

The fifth advantage in this improvement, and of equal consideration, is the cheapness of the article; the price of which has been reduced nearly one-third to the consumer; and when the superior quality of them is taken into consideration, it may fairly be said to full one-half. I mean, when regard is had to their superior quality; and that the muffles may be used over again when broken and ground, with a much less proportion of cohesive clay than in the old mode; and this I conceive to be no inconsiderable advantage; for it is well known, that when the old muffles or broken crucibles can be used without much fresh clay, they are far superior to new materials.

Sixthly. The muffles made in the old way are seldom of equal thickness; whereas those made according to the method which I have the honour to present before the Society, will be found to possess that necessary quality in perfection; for, if an hundred are made from the same mould, they will be all of the same thickness.

Description of the Moulds and Implements.

The first mould for this purpose is a tin one, Fig. 1, (Pl. IX.) which may be made from a piece of tin the size of the arch, being bent so as to form such a concavity as may best suit the purpose to which it is to be applied; this being done, two square pieces of tin, *a a*, must have an arch cut out of them, of such a size that the diameter thereof may be about three-fourths of an inch less than the diameter of the concave piece before stated; these being soldered to each end of the first-mentioned piece, will form a stand for the hollow part of the mould, and the thickness of the muffle moulded in this will be exactly determined by the edge at each end. A piece of hollow tin, *b b*, may be soldered along the top edge of the mould, to form a better resistance to the great pressure within. The next part of this mould is a flat piece of tin,



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tin, Fig. 2, cut exactly to fit the inside of the mould, the use of which is, to form a solid back to the muffles used for chemical purposes.

The second tool for this purpose is a piece of sheet brass, Fig. 3, about six inches long and one broad, which being bent in a semicircular form, and screwed to a piece of wood extending beyond its breadth about an inch, is used for cutting the small air holes *c*, Fig. 11, in the aforesaid muffles.

The third is the tool or frame, Fig. 4, for preventing the contraction of the muffles in drying, which is made of four pieces of beech, about three quarters of an inch broad, and half an inch thick; the length must be adjusted to the mould of the muffle; two of these being laid parallel within the inside of the mould, and being joined across by the other two, the ends of which should extend so far beyond the outer edges of the other two, that they may rest upon the edges of the muffle mould, and thereby prevent its falling into the mould.

The fourth is the tool for spreading the composition into the moulds, which is formed of iron or steel, Fig. 5, about thirteen inches in length, one inch and a half broad, and about one-eighth thick; its face under *h* being rounded in such a manner that its curve may exactly fit the inner curve of the muffle mould, (Fig. 6, is a section of it); this should likewise have a point or tongue, extending from each end, long enough to be bent in the form of a bricklayer's trowel, and by the wooden handles which must be put on, hanging down, it will be found, that, as it is moved either backwards or forwards, it will always present an edge to smooth the composition, and condense it in the mould.

The

The fifth is a frame *d d*, Fig. 15, of which the bottom and farthest side only are shewn, and in which frame the tin mould, Fig. 1, is placed, simply constructed by joining two pieces of wood, the one as broad as the bottom of the muffle mould, and having two narrow groves *e e*, cut in it, so that the edges of the tin mould may be confined therein; the other board being joined to this, at its edge, should come up so high as just to be under the edge of the mould.

The sixth is the tool for cutting the muffles of different lengths, Fig. 7, and is made of a piece of wood, to the end of which is fixed a thin piece of brass *f*, which extending about one inch and one-fourth beyond the top of the wood, is bent at right angles, and made thinner at the end, that it may the more conveniently cut the muffle; under this piece of wood is used another straight piece *g*, with two steady pins, which being shifted at the will of the workman, will cut them of any length.

The seventh is the mould for forming the bottom of the close muffle, Fig. 8, which is made of a mahogany or oak plank, about sixteen inches long, ten wide, and about three-eighths of an inch thick; upon this is fixed a ledge on each side, one inch broad, and nearly half an inch thick, and at each end a ledge of the same kind is placed, at such a distance as is best suited to the length of the bottom required. Fig. 9 and 10, are circular moulds for muffle bottoms of dial plates. Fig. 11, a complete muffle standing on its bottom. Fig. 12, a roller for rolling the composition in the first mould. Fig. 13, a tool for making small holes in the muffle.

The usual composition for making muffles is as follows:

lows: *viz.* two parts pipe-clay and one part sand, such as is used by the bricklayers, sifted, and mixed together to a proper consistence; this is very expensive, on account of the high price of pipe-clay, which is about ten shillings the hundred weight, whereas I employ in my improved mode of making them the coarser kind of Stourbridge clay, which can be had at the glass-houses, in the ground state, for six shillings the hundred weight, and this I sift also, to separate the finer part, which I employ for making other smaller articles necessary in my business; using only the grosser or coarser part for muffles, to which I add one-eighth part only of pipe-clay, mixing them well together with water, so as to form a mass of a pretty thick consistence. The tin mould being first greased, I place it in the frame Fig. 15, shewn under Fig. 1, and having spread the composition in the mould, and smoothed it with the spreader, Fig. 5, till the mould is quite full, the flat piece of tin is then to be well greased, and thrust in at one end of the mould, and the back of the muffle is then formed by spreading the composition, and firmly pressing it against the part already formed. The next thing to be done is to cut the holes in the sides of the muffle, which is done by pressing the semicircular cutter, Fig. 3, into the sides thereof, while it is yet wet, and bringing the piece out entire: the tin mould must now have the frame, Fig. 4, put in, to keep the sides of the muffle from contracting, and being set up end-ways, and a little inclined, it must be dried in the sun, until it has shrunk sufficiently to leave the mould, after which it must be completely dried and burned in the usual manner.

The composition of the smaller implements, or muffle bottoms for dial plates, for the mould Figs. 9 and 10, is made of the finer part of the Stourbridge clay, with a small proportion of pipe-clay.

The rings are made from two parts of Dutch black lead pots, powdered, and one part of pipe-clay. I have made repeated trials of English black lead, in various states, as a substitute for the Dutch black lead pots, but without finding it to answer properly.

Certificates from Messrs. J. Haynes and Son, Westmoreland-buildings; John Kelly, Hooper-street, Clerkenwell; John Foster, Author-street, St. Luke's, and William Foster, Author-street, St. Luke's, state, that they have been in the habit of using, for upwards of twelve months, Mr. Turrell's muffles, and that they are greatly superior to any they have hitherto been able to procure, and that it is their opinion their durability may be completely attributed to his improved method of moulding them.

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An Essay on the Newtonian Demonstration of the General Property of the Lever.

With a Plate.

Communicated in a Letter to the Editors.

GENTLEMEN,

I BEG leave to offer for insertion in your useful publication, an essay on the Newtonian demonstration of the general property of the lever. It was drawn up (*verbatim* as now sent) rather more than three years ago, for a particular purpose; but would probably have never been made public in its present form, were it not that an erroneous and inadequate account of it has found its way into a respectable periodical work; and that what little merit may be due to the extension of Newton's demonstration to the straight lever, has been ascribed to another person, to whom it certainly does not belong. I am, Gentlemen,

Yours respectfully,

OLINTHUS GREGORY.

Royal Military Academy, Woolwich,
Feb. 10, 1809.

On Sir Isaac Newton's Demonstration of the general Property of the Lever, with an application of the same Principles to the Case of parallel Forces acting on a straight Lever. By OLINTHUS GREGORY, *LL. D. of the Royal Military Academy.*

When the importance of establishing upon unobjectionable grounds the fundamental principles, and demonstrating with perspicuity and simplicity the leading theorems, of any mathematical science, is duly considered,

sidered, it will not excite surprize, that in the science of mechanics the attention of many eminent philosophers should have been directed towards the investigation of a satisfactory, yet not complicated demonstration of the properties of the lever. The demonstrations which have been offered at different times by *Archimedes, Galileo, Huygens, Newton, Maclaurin, Fonsenex, D'Alembert, Landen, Hamilton, Prony*, &c. are each allowed to be ingenious, and to carry a greater or less degree of conviction to the mind: but they have all been objected to by one author or another; some of them being thought too complex and intricate, and some to apply only to instances where the arms of the lever are commensurable, while others have been thought to include some principle, which, though perhaps sufficiently obvious to the advanced mathematician, would not be readily admitted by a novice on his entrance upon these studies.

It is not my intention to repeat the objections which have been adduced by Dr. Hamilton, Mr. Vince, and other philosophers, against any of the demonstrations above adverted to. But as I have long been of opinion that the demonstration of our illustrious countryman, Sir Isaac Newton, is more simple, more obvious, and more satisfactory, than any other which has hitherto been proposed, or, at least, with which I am acquainted; I beg leave to present it in a shape rather different from that in which it was first exhibited in the *principia*, and indeed from any in which it has been heretofore represented, that I may more readily show its application to the case of parallel forces acting on a straight lever (an application which it has been supposed it would not admit,

mit, except by a bare induction) and more easily defend it against the most plausible objections.

Besides the knowledge of the celebrated theorem of the *parallelogram of forces* and of statical composition and resolution, the demonstration of Newton requires the admission of only two principles, which may be stated in the form of lemmata, thus:

LEMMA 1. *In every system of an invariable form we may suppose powers or forces to be applied, without changing the effects, at any points whatever in the lines of their directions.*

This proposition is so evident as to be adopted without either proof or illustration, by many writers on the theory of mechanics. Indeed, it must be very manifest that (admitting the convenience of application in all to be alike), if any body be acted upon by a force pushing against it by means of an inflexible bar, the effect will be the same upon the body at whatever point of the bar the force be exerted, the directions of the bar and of the force coinciding: and when the body is acted upon by a force drawing by a straight inextensible cord, the effect will be the same at whatever part of the cord the soliciting force acts: it being supposed in either case that the force is not employed in part in supporting the bar or cord. For, in the first case, at whatever point of the bar the thrusting force F acts, an equal and contrary force F′ will destroy its effect; and in the second, at whatever point of the cord the pulling force φ acts, an equal and opposite force φ' will annihilate its effect.

Lemma 2. Equal and contrary forces acting perpendicularly at the extremities of two equal arms of an angular lever

lever (or two equal radii of a wheel), will prevent it from turning upon its fulcrum or centre of motion.

This is a legitimate deduction from the doctrine of moments, in which it is affirmed that the sum of the moments of forces which tend to produce rotation in one direction, is equal to the sum of the moments of forces which tend to produce rotation in a contrary direction, when the forces are in equilibrio. For the forces being equal, and the perpendicular distances of their directions from the fixed point being equal also, their products, that is to say, the moments, are equal likewise, and the equilibrium obtains.

The truth of this may be made to flow from the proposition that the effects of forces, when estimated in given directions, are not altered by composition or resolution. Thus, let F A, F B (Fig. 1. Plate X.) be the equal arms at the extremities A and B, of which the equal forces act in the contrary directions A P, B P, each tending to produce rotation about F as a centre: since, by the first lemma, the forces may be supposed to act at any points in their respective lines of direction, let them be conceived to act simultaneously at P, the point of concourse of the directions; and let the effects of these forces be both estimated in the direction F P. Let the equal distances a P, b P, in the directions of the two forces represent the magnitudes of those forces estimated in their respective directions; then will a P cos. A P F $= a'$ P, the reduced force a P in the assumed direction F P, and b P cos. B P F $=$ P b' the contrary force reduced to the same direction. But the triangles F A P, F B P, right angled at A and B, having the sides F A, F B, equal, and F P common, are equal in all respects; conse-

Fig. 1.

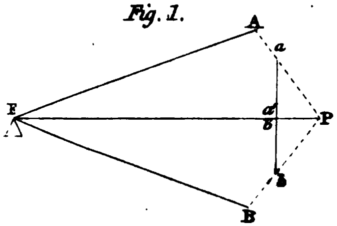


Fig. 2.

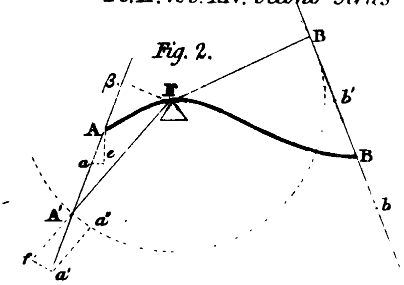


Fig. 3.

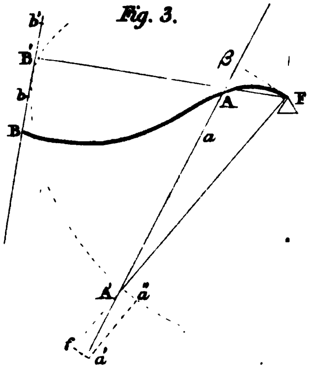


Fig. 4.

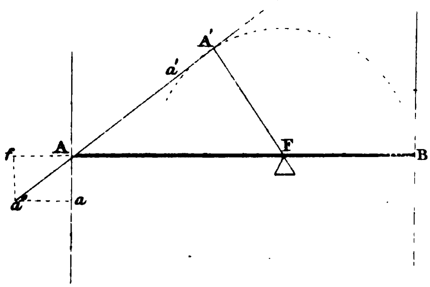


Fig. 5.

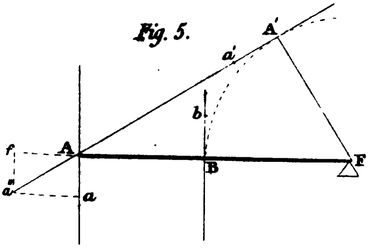


Fig. 6.

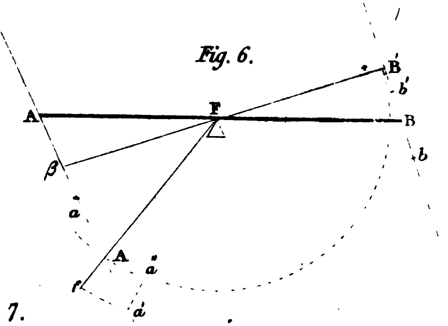
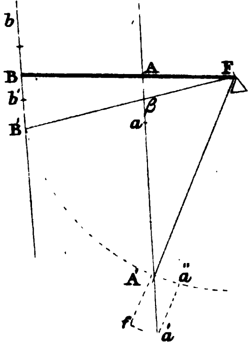


Fig. 7.



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consequently F P A = F P B, and a P cos. F P A = b P cos. F P B, or a' P = P b'. Hence it follows that the two forces represented by a P, b P, produce an equilibrium in the assumed direction F P; and therefore, that the contrary equal forces acting at the extremities of the equal arms F A, F B, are in equilibrio; since it is a well known corollary of what has been stated at the commencement of this paragraph, that, if a system of equilibrated forces in one direction be reduced to any other, the forces will still be in equilibrio.

In fact, it is only to satisfy the more scrupulous, that this lemma has been so long dwelt upon. Most students of the science of mechanics would be satisfied of its truth as soon as they saw that no reason could be assigned why one force should prevail over the other. Or we might say, nearly in the language of Mr. Professor Vince, when explaining the demonstration originally given by Archimedes *, the lemma rests "upon the most self-evident principles," which are, that "*equal* forces acting similarly at *equal* distances, must produce *equal* effects; which is manifest from this consideration, that when *all* the circumstances in the cause are equal, the effects must be equal;" and equal mechanical effects produced in contrary senses must destroy each other's operation.

The truth of the preceding Lemmata being admitted, as I conceive they will generally be, without any hesitation, I proceed to exhibit and apply the demonstration of Newton, to the instances of bent and of straight levers (considered as divested of heaviness) in three propositions.

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* Vide Philosophical Transactions for 1794.

PROPOSITION I.

Any two forces acting upon a bent lever in different directions, but in the same plane, will be in equilibrio, if they are to each other reciprocally, as the perpendiculars let fall from the fulcrum upon their directions.

CASE 1. *When the forces act on different sides of the fulcrum.*

Let the bent lever AFB (Fig. 2, Plate X.) whose fulcrum is F, be conceived to form part of a plane ungravitating, wheel, capable of being moved about F as a centre of motion: and let it be proposed to determine the ratio of two forces P, Q, acting at the extremities A, B, of the lever, in the directions Aβ, BB', and keeping the system in equilibrio. Upon BB' the direction of one of the forces demit from F the perpendicular FB', and from centre F with radius FB' describe an arc intersecting the direction Aβ of the force P in the point A': then, drawing the line FA' we may conceive FA', FB' to be equal radii of the plane ungravitating wheel, and, from the relation of the forces which secure the equilibrium when acting at A' and B', may deduce the relation of the forces P and Q: for it is manifest, from the 2d lemma, that equal and contrary forces acting at the points A', B', in the tangential directions A'a", B' b', will annihilate each other's effects; while, from the first lemma it follows, that a force acting in the direction A'β, will have the same effect at A' as at A, and another force acting in the direction BB' will have the same effect at B' as at B. Let the force P be represented by A*a*, and the force Q by B*b*; make A'*a'* = A*a*, and B'*b'* = B*b*; and, producing the line FA', complete the parallelogram of forces *f a"*. Now, the force $A'a'$ (keeping $B'b'$ in equilibrio) being decomposed into the two, $A'f$ in the direction FA', and $A'a''$ perpendicular to it, the latter only will have a tendency to produce rotation, or to disturb an equilibrium, the former being absorbed by the reaction of the fixed point F. But, by the second lemma, the force $A'a''$ is equal to $B'b'$, that is to Q, in the case of equilibrium: therefore, $P : Q :: A'a' : A'a''$. Also, the similar triangles $A'a'a''$, $A'F\beta$, give $A'a' : A'a'' :: A'F\ (=FB') : F\beta$; consequently, (by equality,) $P : Q :: FB' : F\beta$, or $\frac{P}{Q} = \frac{FB'}{F\beta}$; that is, the forces are reciprocally as the perpendiculars let fall from the fulcrum upon their respective directions. Q. E. D.

CASE 2. *When both the forces act on the same side of the fulcrum.*

In this case, referring to Fig. 3, instead of Fig. 2, the same letters being put to the corresponding parts in both, the reasoning will apply throughout, and the same conclusion will result: and, as the division of the subsequent propositions into two cases will be attended with similar circumstances, there will be no occasion to make this division formally, but merely to adapt two figures to each demonstration.

PROPOSITION II.

If parallel forces, acting perpendicularly upon a straight lever, keep it in equilibrio, they will be to each other reciprocally, as the distances from the fulcrum at which they act.

Here the same general suppositions being allowed as at the commencement of the demonstration of the preceding proposition, let us suppose that the force Q measured by Bb in its own direction, is first balanced (lemma 2.) by the equal force A$'a'$ (Fig. 4 and 5, Plate X.) acting perpendicularly at the extremity of the arm FA$'$ = FB, the direction A$'a'$ produced meeting the straight lever in the point A: then, making Aa'' = A$'a'$, the force Aa'' acting at A, will have the same efficacy (lemma 1.) in turning the system about F, as the force A$'a'$, acting at the point A$'$; it will therefore be in equilibrio with the force Bb = Q acting at B. Resolving the force Aa'' into the two Af, Aa, the former has evidently no tendency to produce rotation about the fixed point F, the latter therefore (Aa) must maintain the equilibrium with the force Q acting at B, and will consequently be the measure of the force P. Now the similar triangles a''Aa, AFA$'$ give Aa : Aa'' : : FA$'$: FA. But Aa = P, Aa'' = Bb = Q, and FA$'$ = FB : so that the preceding analogy becomes P : Q : : FB : FA, or $\frac{P}{Q} = \frac{FB}{FA}$; that is, the forces are to each other reciprocally as the distances from the fulcrum at which they act. Q. E. D.

PROPOSITION III.

Any parallel forces acting upon a straight lever, will keep it in equilibrio, if those forces be to each other reciprocally as the distance from the fulcrum, measured on the lever, at which they act.

Let AFB, or BAF (Fig. 6 and 7, Plate X.) be the lever, F the fulcrum, and AA$'$, B$'$B, the parallel directions in which the forces P and Q act, those directions being here supposed not perpendicular to the lever: then, drawing the several lines as in the diagrams, the reasoning used in the demonstration of the first proposition will apply here throughout, the same letters being placed against the corresponding parts of figures, 2, 3, 6, and 7. Following then the steps of that demonstration, it will be seen, (in figures 6 and 7.) that $P : Q :: FB' : F\beta$: wherefore, since the similar triangles FBB', $FA\beta$, give $FB' : F\beta :: FB : FA$, we shall have $P : Q :: FB : FA$, or $\frac{P}{Q} = \frac{FB}{FA}$, whence the truth of this proposition, likewise, is manifest.

As to the objections which have been urged by different mathematicians against Newton's demonstration of the property of the lever, they may be reduced to three principal ones, all of which will, I hope, be thought of little weight, when the preceding lemmata and propositions are duly considered.

1*st.* It has been objected that the principle of equal forces acting perpendicularly at the extremities of equal arms, producing an equilibrium when they act in contrary directions, can by no means be admitted, since "we are supposed to be totally ignorant of the effects of weights or of forces upon any lever."

To this it may be replied, that when, in the theory of mechanics we attempt to investigate the properties of levers, there is no occasion to pre-suppose that we undertake this while we are "totally ignorant of the effects of weights or of forces upon any lever:" on the contrary, it may be fairly imagined that, previously to undertaking this inquiry, it has been ascertained, either by experiment or from reasoning, that equal forces acting similarly, though in contrary senses, upon equal arms of any lever, produce an equilibrium; and farther, that when equal forces act on the arms of a lever, that which is farthest from the fulcrum will prevail; for it is only some such preparatory knowledge that would in general induce a theorist to inquire what is the universal invariable law or relation which subsists between forces or weights acting upon a lever at any distances, or in any directions. Besides, every theorist *must* be supposed to come to this investigation prepared to acknowledge the truth of the second lemma, since he must have a previous acquaintance with the usual theorems relative to the composition and resolution of forces; and ought to be aware that the theorems are very confined in their utility while they are restricted to forces acting simultaneously upon a physical point; but that then only can they be of much essential service in the science of mechanics, when it has been shown, that if several forces acting at once upon different points of a body, keep it in equilibrio, they are such as would balance when all act at one point, their directions continuing respectively parallel; because with that extension the theory may be applied to levers of any shape (as well as to other bodies) either supposing such levers to be divested of heaviness, or supposing the force of gravity to be one of those employed in the equilibrated system. And this remark will suggest an answer to most of the minor objections.

2ndly. It has been objected, by Dr. Hamilton, that Newton's demonstration, though confessedly simple, "depends on this supposition, that, when from the fulcrum of a lever several arms or radii issue out in different directions, all lying in the same vertical plane, a given weight will have the same power to turn the lever, from whichever arm it hangs, provided the distance of its line of direction from the fulcrum remains the same. Now, (the Doctor observes) it must appear difficult to admit this supposition, when we consider that the weight can exert its whole force to turn the lever only on that arm which is the shortest, and is parallel to the horizon, and on which it acts perpendicularly, and that the forces which it exerts, or with which it acts perpendicularly, on any one of the oblique arms, must be inversely as the length of that arm, which is evident from the resolution of forces."

Now, if the consideration of forces in general, be substituted for that of weights, which will no way effect the principle of Newton's demonstration, we shall thus get quit of the inadequate conceptions resulting from confining the attention to one kind of force only, and prepare the mind for the ready admission of our first lemma, which, in fact, removes this objection. Indeed it is not a little curious that Dr. Hamilton's own reasoning seems to contain a reply to the objection he advances: for, it may easily be shewn that the equal forces Aa, $A'a'$, for example, (Fig. 2.) acting in the same direction upon the extremities A and A' of the arms FA, FA', *are* inversely as these arms when estimated in directions perpendicular to them, and consequently, that each has the same tendency to produce rotation about the centre F. Thus Ae being equal to $A'a'$, and the triangles Aae, $A'a'a''$, right-angled at e and a'', we have $Ae : A'a'' :: \sin. a : \sin. a'$. But FA and ea being parallel, we have $FAa = 180^\circ - a$, and consequently $\sin. a = \sin. FAA'$: while $\sin. a' = \sin. AA'F$, the line Aa' cutting the two parallels FA', $a''a'$: hence, it follows that $Ae : A'a'' :: \sin. FAA' : \sin. AA'F$. Now in the triangle FAA', we have $FA' : FA :: \sin. FAA' : AA'F$; whence, by equality, $Ae : A'a'' :: FA' : FA$; or, by making equal the products of the mean and extreme terms, there results $FA . Ae = FA' \cdot A'a''$; these equal rectangles being the obvious measures of equal tendencies to produce rotation.

3rdly.

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3rdly. It has been objected to Newton's demonstration that it wants *universality*, being inapplicable to the case of parallel forces acting upon a straight lever: this objection is removed by the second and third of the foregoing propositions.

I might now restore the consideration of gravity (which has been hitherto excluded in the investigations) to the several bars issuing from the centre of the wheel; and show with what facility the preceding principles, combined with the known properties of the centre of gravity, would contribute to the establishment of the various theorems appertaining to the different kinds of heavy levers, the pressures on their fulcrums, &c: but this would draw us too far from the professed objects of this paper, which were to defend the principles adopted by Newton from objections, and to show that they apply to straight as well as to bent levers, contemplating both merely as inflexible bars divested of heaviness: such being the point of view in which they were considered by our illustrious philosopher, in his *Principia*, and in which they are commonly considered in treatises of mechanics. If I shall have been so fortunate as to evince the preference of Newton's demonstration to any of the others mentioned in the beginning of this communication, and to show that it may be accommodated to the case of straight levers, so as to furnish a proof more simple and natural than either that of Archimedes or of Galileo; I shall please myself with the reflection that this Essay may be of some utility to those who are engaged in either the cultivation or promotion of an important branch of science.

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A Treatise on the Diseases of Sheep; drawn up from original Communications presented to the Highland Society of Scotland.

By ANDREW DUNCAN, *Jun. M.D. F.R.S.E. and A.L.S.L.*

(Continued from page 196.)

STAGGERS.—"This is a disease seldom or never affecting the sheep in this country, those excepted who feed in forests or amongst planting. The symptoms of it are more violent than those of sturdy during the time of their continuance. The animal after staggering for some time falls on the ground, when a general trembling comes on over the limbs; they are violently convulsed, and quite insensible to every thing. During the continuance of the paroxysm they throw the body into various positions, and sometimes roll to a considerable distance. The fit continues for a quarter, sometimes half an hour, or an hour. When they rise they seem perfectly bewildered till they regain the flock, when they continue to feed well till another paroxysm supervenes.

"This disease appears in autumn, and various causes are said to produce it. Improper food, the leaves of the oak, from their astringent quality *, cobwebs sprinkled with dew, have all been reckoned as causes. I am inclined, however, to suppose that it arises from the action of a poisonous grass *(Lolium temulentum)*, which is the only one of that description in this country, and grows only in those situations where staggers prevail. What effect these causes have on the brain, to produce this disease, I cannot explain.

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* Anderson's Recreations, Aug. 1790.

"When it continues for any time on the same individual it is apt to be fatal. Change of pasture is the only effectual cure for it." Mr. Stevenson.

Pining, Daising, or Vanquish.—This disease, as described by Mr. James Hog and Mr. Beattie, is also most severe upon young sheep, but is chiefly confined to some particular districts in the west of Scotland, where the land is very coarse, hard, dry, and heathery. It always fixes on the best of the flock, and although they continue to feed most greedily, they daily pine away to a mere skeleton. It is fortunately not a dangerous disease, for on removing them to soft grassy pastures, especially such as have been recently limed, they immediately recover, and never fail in future to become excellent sheep, and remarkably healthy. Although in regard to the gradual wasting of the animal, this disease has some resemblance to the rot, in its nature and cause it is directly the reverse. The rot arises from excess of moisture, is a disease of debility, and characterised by extreme thinness of the blood; in the pine, on the contrary, the condition of the animal is too high, its blood too thick, and its pasture too arid.

The following description of the vanquish, by Mr. Singers, however, is so different from the above, that it scarcely appears to be the same disease.

"Peat mosses, having a northern or eastern aspect, are unsafe pastures for young sheep after the autumnal equinoxes; if there be not other soils on which they can occasionally feed, and especially if the season be cold and moist. These farms which consist wholly of peat moss, are not well adapted to carry on ewe and lamb stocks throughout the year. I have known of such farms that could not, without difficulty, be let for sheep walks, unless to such farmers as had command of drier sounder pastures, to which they could remove their sheep at the proper season. Without this resource the young sheep were attacked by the vanquish, which consumed them entirely away. This malady has its seat, as practical shepherds believe, chiefly in the blood and bones: but it seems in a little time to spread over the whole system, which becomes debilitated and emaciated. Cold and moisture assist in bringing it on, and also aggravate the symptoms; but there must be a principal fault in the mossy soil.

"The earliest common pastures for sheep in spring are peat mosses. The bog cotton, *Eriophorum*, flowers as early as April, and gives the first food of the season to sheep and bees; the sheep drawing the white stalks, and the bees finding pasture on the flowers. Mosses are therefore of importance to the sheep farmer at this early season of the year. They also furnish a considerable quantity of summer food, principally from the plant called *Scirpus cespitosus*, Deer's hair; but early in August this plant becomes wiry and unpalatable. There is then frequently heath in the mosses, but it does not appear to be so grateful to sheep as that of the dry moor, or a gravel bottom. The heath of mosses has been found not to grow so kindly after being burnt as that of drier gravelly soils, and therefore is either scanty, or woody and rigid for the most part. These defects in the heaths of mosses may be in part occasioned by neglect: they are suffered to be too old ere the torch is applied, and afterwards, when burnt, they die from the roots; but the excessive moisture frequently puts it out of the farmer's power to manage his moss heaths as judiciously as those of his moors and gravelly soils. And the same excess of moisture may probably affect the qualities and healthiness of the heath as food for sheep. There is also in peat mosses a greater proportion of cross-leaved heath, *Erica tetralix*, than we find on dry walks; and most people seem to think, that the sheep do not relish this sort of heath so well as the common heath, *Erica vulgaris*, when the shoots are young.

"Change of pasture, from the peat moss to one that is sweet and dry, at or before the equinox, till March following, is the best known cure for the vanquish, and seldom fails to prevent it."

Diarrhœa *.—The early grass of soft and tathy pastures, and such as are subject to be inundated through the winter and spring, which is eagerly sought after, and greedily devoured by animals, worn out by the fatigue and hunger of the preceding winter, is apt to produce purging among the hogs, and if they be lean, among the dimmonts and eild gimmers. Its appearance and progress are determined by the forwardness and wetness of the season. It commonly begins in April and ceases in June, when the grasses in general become firmer and less succulent; and among the great variety which then appear, there are some of an astringent nature. In general the animal begins to thrive as soon as the cause is removed, and seldom experiences a relapse the same season. In some instances, however, it continues for a great length of time, but is rarely fatal, unless the animal has been previously much debilitated.

On opening the body the bowels appear white and bleached, but in some places streaked with red. As well as the stomach, they are generally empty, containing

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* Diarrhœa or Dysentery, Mr. W. Hog. Purging, or Rush, Mr. Stevenson. Diarrhœa, or Rush, Mr. Laidlaw.

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ing nothing but air. When the disease has been severe, or long continued, the internal coat is sometimes abraded from the intestines, and even from the fourth stomach. The carcase is completely emaciated, no fat being found on the bowels, or even in other parts, or at least it has lost its unctuous nature, and is converted into a whitish tough substance.

On other occasions purging is not only produced by cold, but also by change of food, from wholesome and dry to damp and soft pasture, or from poor and sterile situations to those that are rich and fine. At times also it is the consequence of other diseases, such as collections of matter, sickness, jaundice, &c. and often removes them.

Astringents might be employed for the cure of this disease, but seldom any thing else is administered but sweet milk, whose costive and nutritive properties, stopping the rush, and invigorating the debilitated system, a cure is speedily performed.

All kinds of grasses which grow on a mossy soil are possessed of strong antiseptic qualities, and of course are exceedingly useful in preventing sheep from being attacked with this disorder.

Mr. Stevenson alone is more particular in his observations on the cure of this disease.

"When the disease arises from cold, (which may be known from the state of the weather;) putting the sheep into the house for a few days, and feeding them on dry hay, will speedily prove a cure.

"When it arises from too rich pasture, they should only be admitted to it for a certain time of the day, and put into a pen at night, with some dry hay to eat, or turned into hill pasture. This should be attended to by graziers having rich pasture, who at times lose a considerable number from this cause alone. When once they are gradually accustomed to this food, the hay and other precautions become unnecessary. Where looseness depends on damp and wet grass, or wetness in the spring season, a little dry hay given at night in the fold has a good effect in checking it.

"We come now to speak of that kind of purging which depends upon weakness and relaxation of the bowels, and in which alone the aid of medicine is necessary.

"In this kind of purging the sheep should have as dry pasture as possible, and even a little hay mixed with it. It is in general advantageous, in the first place, to clear the bowels from any irritating matter by a dose of an ounce of Glauber's salts, or the same quantity of common salt; after which the indication is to bind up the bowels by astringent medicines, and prevent the return of the disease, by using such medicines as are calculated to strengthen the bowels.

"Sometimes, as was before mentioned, a purging is a consequence of *fever*, &c. In which case it is critical and ought not to be stopt. In cases, however, where it is weakening the body greatly, and depends on laxity of the bowels, we must have recourse to the medicines we have recommended in a particular stage of braxy.

Take of logwood ¼ lb.
Water 2 lbs.

Boil it into one pound, and add a little cinnamon. A gill of this to be given morning and evening. If this in eight days have not the effect of carrying off the disease, add to every dose ten grains of powdered Japan earth *(extract of Catechin)*; these, from their astringent quality, prevent the frequent motions of the bowels.

"Twenty drops of laudanum form a valuable addition to every dose, when the rumbling and noise in the bowels is excessive, or when the disease has continued long.

"We may take notice in this place of what is denominated by shepherds the *black purging*, which is generally the consequence of some previous disease, as rot, braxy, sickness, &c. It proceeds, like the black vomit in the yellow fever, from mortification having taken place in the bowels, and part of their coats coming away, mixed with acrid and thick *bile*. It is always fatal, and the sheep should be killed as soon as it appears, to preserve the carcase, which in this disease, notwithstanding it is bled, has a disagreeable smell, and the flesh is quite soft.

"Sometimes it proceeds in harvest from the heat causing a redundancy of bile; but even in this case it is always fatal, as the constitution of the animal receives such a shake as it never recovers."

Dysentery *.—This disease is in every respect analogous to the dysentery in men; arising from similar causes, being attended with similar symptoms, and yielding to similar remedies.

It is not peculiar to any soil, but appears most frequently, and spreads most rapidly, where the pasture is soft and grassy. It is always generated by improper management, such as working among the flocks inconsiderately in sultry weather, and in crowded folds. "It most frequently breaks out," says Mr. Beattie, "in milking-time, when the sheep lie for six or seven weeks in the warm months of July and August upon the same spot for some time, morning and evening at the bught. Indeed, when sheep, from whatever cause, lie upon the same spot till the ground turns foul, if the weather is soft, sultry and warm, with thunder or thunder showers, Dysentery * is much to be dreaded, and it is epidemical beyond example."

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* Dysentery, or Cling, Mr. Singers. Dysentery, or Braxy, Breckshaw, &c. Mr. Beattie, Mr. Stevenson, Mr. Laidlaw, Mr. Welsh, Breakshuach, or Cling, Mr. J. Hog, Mr. W. Hog.

When a sheep becomes affected with this disease it acquires a sickly look, its ears drop, and hang low down, its eyes are languid, and its wool claps to the body. For some time it continues to follow the flock, but generally stands in one position, looking to the ground. It often lies down, but soon rises up again, and walks to a short distance, during which it commonly voids fœces. Its skin is hot, dry, and scaly, and its pulse and respiration quick. It eats very little, and does not chew the cud, but seems to have an unquenchable thirst. There is frequent rumbling heard in its bowels, followed by the passage of fœces, which are thinner than ordinary, having little or no resemblance to the hard purl of healthy sheep. As the disease advances the purging increases, the discharge becomes thinner, and mixed with blood, then slime and blood, and at last it is black and fetid, evidently accompanied with severe gripes and straining. After a wet summer, the discharge is frequently green, the grass appearing to pass with little change of colour. In the mean time the animal rapidly wastes away, being

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* In this and other quotations I have taken the liberty to substitute *Dysentery*, for the author's term *Braxy*, which by many is used to denote a very different disease, the *Sickness*, and might thus lead to mistakes.

reduced in a day or two to a perfect skeleton, with its belly drawn up to its back; it separates from the flock, wanders unsteadily about, and hides itself amongst fern or heath. Its eyes are suffused with red, its breathing becomes more laborious, an unpleasant smell exhales from every part of its body, its fœces are absolutely putrid, it is quite overcome by the disease, and it continues straining and purging till it dies.

If a sheep survives the disease a fortnight, Mr. J. Hog says four days, it generally recovers. In this case, there is either very little or no blood in the fœces, the slime dries up, and is mixed with hardened balls, the feverish heat abates, the skin becomes moist, the vigour of the eye returns, the appetite increases, and the wool rises slowly, and assumes its natural appearance, but great part of it frequently comes off. It, however, grows on again, and sheep which have had the dysentery generally become very healthy and sound, and are seldom attacked by any other disease.

Sometimes the flux never breaks out at all, but the fever and other symptoms are the same. This is called the *dumb braxy*, and is neither so fatal nor so epidemical as the other, although, when they recover, the wool drops off in the same manner.

Although the dysentery is always originally generated by improper management, it is highly contagious, and spreads rapidly from individual to individual, and from flock to flock, "so much so," says Mr. Beattie, "that if a flock which is much infected with the braxy lies between a sound flock and the wind, although at half a mile's distance, the sound flock will catch the infection. For which reason all the neighbouring shepherds are greatly alarmed when the dysentery breaks out, as their flocks often catch the infection, notwithstanding all their efforts to prevent it."

It is a very dangerous malady. On a soft soil the greater number of those infected with it die; but on a dry hard soil it is less fatal, and less contagious.

Appearances on Dissection.—The carcase immediately after death has a peculiar unpleasant smell, and is commonly distended with air. On opening the body, the fat of the omentum seems to be wasted away, or to have acquired a reddish colour, and there is a general redness diffused over the whole contents of the abdomen. The veins of the mesentery are remarkably turgid. The stomach and bowels are filled with fetid air, but contain no fœces, except a little slimy matter. The intestines, especially towards the anus, are often livid, thickened, and ulcerated on their internal surface. The muscles soon become green, and do not lose their unpleasant flavour even when salted. The subcutaneous and muscular fat is less wasted than might have been imagined.

Diagnosis.—Dysentery is distinguished from ordinary diarrhœa, by the following characters. 1. Diarrhœa attacks chiefly hogs and weak gimmers, and dinmonts; whereas dysentery is frequent among older sheep. 2. Diarrhœa almost always occurs in the spring, and ceases about June, when dysentery only commences. 3. In diarrhœa there is no fever or tenesmus, or pain before the stools, as in dysentery. 4. In diarrhœa the fœces are loose, but in other respects natural, without any blood or slime; whereas in dysentery, the fœces consist of hard lumps passed occasionally, the rest being blood and slime. 5. There is not that degree of fœtor in the fœces in diarrhœa, which takes place in dysentery.

6. In dysentery the appetite is totally gone, in diarrhœa it is rather sharper than usual. 7. Diarrhœa is not contagious: Dysentery highly so. 8. In dysentery the animal wastes rapidly, but by diarrhœa only a temporary stop is put to its thriving, after which it makes rapid advances to strength, vigour, and proportion. 9. Dysentery is commonly fatal, diarrhœa rarely, unless the animal has been previously much debilitated.

The *dumb braxy,* as it is called, is distinguished from sickness by the season of the year in which it appears, and by dysentery in its common form of a bloody flux, affecting other individuals in the same flock at the same time.

Means of Prevention.—" The precautions which skilful farmers use to prevent the appearance of this disorder, are of far more benefit than any thing that can be done after the disease is broken out. They endeavour to allow their sheep to pasture easily and freely, and to *skail* them, as we term it, as equally upon the ground as possible, so that no one part of it, by their gathering in bulks, may be tainted or foul. In milking-time they choose a high airy situation for their bughts, where they have a free current of air. Dry bent ground is reckoned the best for a bught, where the surface is not easily broken, and they shift the bught frequently before the ground turns foul, to keep the sheep clean, and to prevent any smell. They divide their sheep into equal bughtfuls, for the most part counting them, so that they may never get a heat by being too throng, which is apt to make them nist, that is break out in a flux, which taints the ground. They change the places where they lie, when at the bught, before it grows foul, and when the situation of the ground will permit,

mit, they sometimes shift their bughts to another quarter."

"When the disease appears, we remove those that are infected among them, as speedily as possible, to a considerable distance, and put tar upon the noses and roots of the tail of every sheep, and set a tub of tar down at the bught, stirring it occasionally. This we do from the persuasion that it may stop the infection, as men use sulphur and vinegar with the same design. If the disease still rages, we smear or salve a number of them, and let them go from the bughts to a clean pasture, and lie at their ease. This, for the most part, makes it abate, but sometimes they continue dying, even after they are all smeared, until the frost sets in, and then it subsides, after a great loss."

Cure.—Farmers in general attempt to cure the dysentery in sheep, by taking them into the house for twenty-four hours, giving them Peruvian bark and laudanum, in as little cold water as possible, and then confining them in an inclosure where they can get no water. If the flux continues, and the animal lives, the same process is repeated every two or three days, till the flux stops; but it is long before they are allowed to rejoin the flock, lest they should still communicate the disease. This method of treatment, however, they confess is not very successful, and with a candour much to their credit, look up to medical men for pointing out to them a mode of treatment which may be more efficacious, in consequence of its analogy with dysentery. As Mr. Stevenson combines in himself the qualifications of surgeon and farmer, his opinions are entitled to particular attention. If the sheep are in good condition, and the weather rather cold, the cure may be begun by cutting the tail across. Stoving the sheep in a hot-house, or heating them in such a degree as to bring on perspiration, is attended with great advantage. This is more easily affected when they have been previously bled, and if it be copious and general it seldom fails to carry off, or at least greatly to relieve, the disease. Care, however, must be taken not to expose them suddenly to the common temperature of the atmosphere, lest the cold occasion a relapse. At the same time it will be necessary to clear the bowels by an ounce of Glauber's or common salts, or half a drachm of rhubarb; or, what is better, four grains of ipecacuanha repeated every two hours till it purges freely. Should the other remedies not operate in four hours, the dose may be repeated. The next indication is to sheath the bowels, by giving a quantity of thin flour porridge well boiled, and barley meal or oat meal may be used in the same way, along with half a mutchkin of sweet milk, morning and evening.

If these do not succeed after being used for two days various astringent medicines may be used, with a view to check the preternatural determination to the bowels, and diminish their increased action.

Take of logwood, 3 ounces,
Boiling water, a Scots pint,
Allow it to stand 12 hours, and then give a gill morning and evening; or

Take of oak bark, 4 ounces,
Boiling water, a Scots pint,
Infuse for 12 hours, and give a gill twice a day;

Take of Japan earth in powder, 1 ounce,
Boiling water, a chopin,
and give a gill twice a day; or

Take two ounces of chalk,
Boiled in a choppin of milk,
And give one half in the morning, and the other half at night.

Fifteen drops of laudanum are a very necessary addition to all the foregoing recipes. Given to the extent of thirty drops a day, it is attended with very excellent effects, as it lessens the pain in the bowels, and prevents, during the time of its action, *their* violent motion. It has also an effect in lessening the frequency of the stools, which cannot take place when the motion of the bowels is retarded. If none of the others can be had, it may be given by itself, fifteen drops three times a day, after the bowels have been cleared by a purge, in the way already mentioned, as will be exemplified by the following cases."

Cases of Dysentery. Drawn up by Mr. Stevenson.

Case I.—On the 12th of August 1800, a sheep was observed by the shepherd to be affected with braxy. It was brought home, and put into an inclosure at the back of the house. The wool was not clapped, but the eye was languid; the mouth dry, the skin rough on being felt, frequent rumbling was heard in the bowels, the pulse, felt at the neck, was quick. It had frequent stools, which had a slimy appearance, and were mixed with blood; and a few hard balls were observed to come amongst some of the stools, at each of which it drew up its hind legs, and seemed to suffer pain. As it was in good habit of body, it was bled in one of the veins in the fore leg, and about two ounces of blood, of a dark colour, taken from it. A dose, of an ounce of salts, was then administered, which in eight hours produced several passages, and the pain in the bowels seemed in some measure to be abated. Next day five grains of ipecacuanha were given every two hours, for five hours, which still kept up the purging; and considerable sickness was apparent. In two hours after the operation of the ipecacuanha, it began to eat a little, and the skin was somewhat moist. The frequent stools now abated, and there was no more purging, nor was any more blood passed. In six days it was so far recovered as to be able to join the flock.

Case II.—On the sixteenth of the same month, 1800, a sheep was brought home, in which the disease had continued for several days. The stools were very frequent, slimy, and mixed with blood, having little feculent matter in them; the wool was clapped, the mouth and skin dry, the eyes languid and red, constant rumbling in the belly, and the animal could with difficulty stand. On laying the hand on the belly it could be felt in some parts as it were drawn together, and lumps in parts of it. A dose of half a drachm of rhubarb was given to it, which operated in eight hours, several times, and brought away a quantity of fœces, more of the natural appearance, only thin; and next day, eight doses of ipecacuanha were given every two hours. The purging continued, but not so much blood nor slime for two days, at the end of which four ounces of logwood were taken, upon which was poured a Scots pint of boiling water. When it had stood for twelve hours, a gill, or four ounces of the infusion was given morning and evening, having fifteen drops of laudanum added to each dose.

In six days the stools had ceased in their frequency, and the feverish appearance was gone off, and the animal had begun to take its food. From this time there was nothing more done to it, and in twelve days from its first being brought home it was returned to the flock.

Case III.—In the month of September, 1800, a sheep was brought into the inclosure, from a neighbouring farm, the proprietor of which had before witnessed the successful treatment of the other two cases. The disease had continued twelve days, and the animal was very much exhausted. The wool was clapped, and a very considerable quantity of blood was passed at each stool, the mouth and skin were dry. It took no food, and the pulse was quick. A dose of salts was given to it, an ounce, which operated well. Next day, four doses of ipecacuanha were given, of four grains each, which also operated, and by which the purging stopt for six hours. There was no appetite; and a number of hardened pieces of fœçes were passed, mixed with black blood. The heat of the body continued. Two ounces of logwood were infused in a chopin and a half of water, and given in the quantity of a gill, three times a day, with the addition of fifteen drops of laudanum. This was continued for four days, during which time, however, the blood still continued to be passed, with an admixture of a substance, like the matter of an ulcer; and on the 17th day from the first attack the sheep died.

On looking into the belly, the bowels had all an inflamed appearance, and a considerable proportion of the lower intestine was ulcerated in the inside; its coats were thickened, and its outside was of a blackish hue. There was a quantity of fetid air in the bowels, which turned a silver probe quite black, as it did also a shilling exposed to it. The flesh was soft and red, but the heart,

liver,

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liver, and brain were sound; the kidneys were slightly enlarged and flabby.

Case IV.—In August, 1800, a sheep was brought home affected with braxy, the symptoms were as formerly described: it seemed much exhausted, and had been observed affected for seven days. It got first, four grains of ipecacuanha, every two hours, for three times, which purged it a good deal. It was then placed in a small house, where was a large cast-iron boiler, which being filled with water, and the door shut, from the heat of the furnace below, it soon filled the whole house with steam, in which the sheep continued for the space of three hours, when the fire was taken away, and the sheep remained in the heated house all night. There was a great perspiration over its body, and the wool was quite wet. It was taken out at mid-day, and the infusion of logwood and laudanum given to it three times a day. It seemed a little better, and the stools not so frequent. Wool still clapped. Next night it was shut up, and stoved again, and some flour porridge was given to it, with a little milk. Next day the medicine was continued. The symptoms had abated, but the wool clapped. It was not again stoved, and the medicines were continued for twelve days, before it was quite recovered.

Case V.—In this case the treatment was the same as in the first and second cases; but there was such a degree of debility that the porridge and astringent medicines were continued for nearly four weeks before it was recovered.

Case VI.—In August, 1800, a sheep was brought in with braxy, the symptoms very violent. It had a dose of salts, which operated, but it died next day. In this case the bowels were affected considerably higher up, being at the junction of the small and great guts, where mortification had taken place. The lower bowels had a number of round hardened balls in them, and a very disagreeable smell was exhaled.

I deem it unnecessary to mention any more cases, which all occurred in the same year, as braxy has not appeared since 1800; and I have had no opportunity of making experiments upon it since that time. The practice in that year was very successful, as five were saved out of seven that were brought home, and a fair trial instituted: but from carelessness, nearly one out of three died before any thing was done to them.

Scab, or Itch.—This disease is only known by name, over a great part of Scotland, but even in the most distant Highlands and Hebrides, it has of late years made considerable depredations.

The infected sheep become restless, and instead of feeding quietly, tear off the wool with their teeth, and go in search of stones and banks, against which they may rub themselves. The skin, when narrowly inspected, has a red fretted appearance, and emits a peculiar ichor, which hardens into scabby crusts. These fall off, and are succeeded by others still larger. The wool gets a dirty brownish appearance, and falls off prematurely, and the animal ceases to grow, or loses flesh, and pines away; and if not cured by medicine, at last sinks under the continual irritation and poverty occasioned by it.

It is highly contagious, and when once introduced into a flock lessens its value more than one half, by very quickly infecting the whole, not so much by direct contact, as by means of the rubbing places; so much so, indeed,

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deed, that when to get rid of it whole flocks have been exterminated, the disease has sometimes appeared in fresh stocks laid on their pasture, in consequence, probably, of infectious matter or animalculæ still adhering to the stones or banks, or other rubbing places,

But it may also be brought on by poverty and overheating, or by making them lie too close together during the warm summer months, or by lying under the drop of trees. Spring, however, is the most critical season for it, and the same soil, grass, and weather which induces the rot, are also considered hurtful in the scab.

It is never generated in flocks which are salved or smeared with butter or tar, which was universally the custom in Scotland. But salving does not prevent its being introduced by infection.

The white-faced, fine-woolled sheep, are most liable to it. Hogs or young sheep are its most common subjects; and in a flock the rams, which are naturally slovenly, indolent, and foul-feeding, are usually first affected.

As soon as it is discovered, the utmost care is necessary to put a stop to its progress, by removing or killing those suspected of being infected, and salving the others, if the season permit.

The scab is, however, by no means an incurable disease. Mr. Stevenson recommends a tea-spoonful of sulphur combined with treacle, and diluted with water, to be given them for some mornings, while all the parts affected are carefully rubbed every night, for five or six times, with one or other of the following applications.

Take of sulphur, three ounces,
Tobacco liquor, a chopin, (two pints English,)

Put them on the fire till they boil, and use it when cold. This is similar to an application of some of the South Down farmers, viz. a decoction of tobacco, wild-vine root, and sulphur, boiled in brine for a quarter of an hour, strained off, and poured on the affected parts, separating the wool.

Take of tar, a pint, (four pints English,)
Butter, two pounds. Mix them well.
Take of sulphur, half a pound,
Butter or lard, two pounds. Mix them well.

Mercury, however, is by far the most effectual remedy, although attended with some danger. The following is Sir Joseph Banks's method of applying it.

Take of quicksilver, one pound,
Venice turpentine, half a pound,
Oil of turpentine, half a pint English,
Hog's lard, four pounds;

Rub the quicksilver and Venice turpentine together in a mortar, until the globules of mercury disappear, then add the oil of turpentine and hog's lard, and mix for an ointment.

Apply the medicine, if possible, in dry weather, in the following manner. Begin at the head of the sheep, and proceeding, from between the ears, along the back, to the end of the tail. The wool is to be divided in a furrow, till the skin can be touched, and as the furrow is made, the finger, slightly dipped in the ointment, is to be drawn along the bottom of it, where it will leave a blue stain on the skin and adjoining wool. From this furrow similar ones must be drawn down the shoulders and thighs, to the legs, as far as they are woolly; and if the animal is much infected, two or more should be drawn on each side, parallel to that on the back, and one down each side, between the fore and hind legs. Immediately after the application, the sheep are turned out among the rest of the flock, without fear of infecting it, or of sustaining injury themselves. The blotches dry up, and the sheep are cured in a few days. In Lincolnshire the farmers used to anoint their sheep with it when they come home from the common, whether sound or not, and persons contracted to apply it effectually at five shillings *per* score of the large sheep of that county. Instead of the above, the common mercurial ointment of the shops may be used, and some shepherds rub the parts affected only, others the naked parts of the thigh and leg, and others apply it by tying a worsted cord, well soaked with it, around the neck.

Redwater.—"This disease commonly makes its appearance about the beginning or end of winter, and first affects about the breast and belly, although at times it spreads itself over other parts of the body. It consists in an inflammation of the skin, that raises it into blisters, which contain a thin, reddish, and watery fluid. These continue for a short time, break, discharge their matter, and are followed by a blackish scab.

"When the sheep are exposed to cold or wetness, the skin being fretted, makes the blisters rise, or they often arise from cold, affecting the animal internally, thus producing a slight fever, which throws out these vesicles on the body, similar to the scabby eruptions which appear about the face, and more particularly the mouth, of those persons affected with cold. The blood, in this disease, is but little affected, although a little of it oozes into the vesicles on the skin, and communicates to them that reddish tinge which gives origin to the name.

"Redwater is a disease that but seldom appears in this country, and is almost never fatal. In cases where the disease is violent, a little blood should be taken, in the manner described. The sheep should be placed in a fold by itself, the blisters slit up, and a little infusion of tobacco put into them; and the following medicine may be given for three or four mornings, successively:

Take of flower of sulphur, 2 ounces,
Honey, treacle, or syrup, 3 ounces;

Mix them, and divide them into six doses, of which one may be given every morning, in half a pound *(half a mutchkin)* of warm water. If this is found unsuccessful, half an ounce of nitre mixed with the foregoing receipt will be attended with good effects; after which a dose of salts may be given, and the body washed with lime-water upon the parts affected." Mr. Stevenson.

Erysipelas, or Wild-fire.—"This, like the last-mentioned disease, also affects the skin, and is apt, if not attended to, to spread very quickly among the flock. It is attended with more inflammation than the last; and but seldom with blisters over the body. It commonly appears in August and September, and does not continue above eight days at a time, although those sheep once affected with it are liable to relapse. In former times, it was a practice with shepherds to bury those sheep affected with this disease at the door of the fold with their feet upwards, which they believed acted as a charm to drive it from the flock. This, however, is now disused.

"It is necessary, for the *cure* of this disease, to follow the same method recommended in the Redwater. An ounce of salts, dissolved in warm water, given every morning for three or four days, answers remarkably well to

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to begin the cure, when the last-mentioned receipt, with the addition of the nitre, may be continued till the disease disappears." Mr. Stevenson.

Foot Rot.—This disease appears in August, and is more frequent among long than short sheep. It seldom occurs in clean walks, but is very troublesome on dirty soft pasture. It is frequently occasioned, in the milking season, by the bughts being dirty, and by the sheep confined in old houses. It resembles the whitlow, and it commonly affects the fore feet, but sometimes all four. The outer part of the hoof is the usual seat of the disease; and from the cleft a sharp fetid humour exudes, sometimes engendering maggots, and corroding the flesh, and even the bone. Around the hoof there is an inflammation, which turns black, and the hoof sometimes drops off. It is a very painful disease, so that the animal frequently walks on its knees. When the weather gets cold it commonly gets better, but it still walks lame.

As soon as the disease appears examine the foot, and endeavour to open the diseased part, and let out the ichor. Wash it well, and dress it with mercurial ointment, and sulphur, or tar with red precipitate; and bind it up with flannel, to keep it warm and clean. When it resists suppuration, and degenerates into a foul and tedious ulcer, spirit of turpentine, and even sulphuric acid are applied. In all cases the animal must be kept in clean, easy, dry pasture, till it recover.

*Leg Evil**.—"This complaint arises most commonly amongst the South Down, or Leicester breed of sheep, but after it appears in a flock, the black-faced or Scottish sheep are equally subject to it. It has almost never appeared to the north of the Tweed, although of late years it has been pretty common on its southern bank, in Selkirk, Roxburgh, and part of Peebles-shire. This may, in part, be owing to the long or white-faced sheep being there principally kept.

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* Black leg, Mr. Beattie. Leg ill, Mr. Scott.

"This disease generally begins at the knee, which swells to a considerable size, causing such a degree of lameness as to prevent the sheep affected from following the flock. Sometimes it begins at the head of the hoof. It is of a bluish or livid colour; sometimes, indeed, frequently, having small blisters scattered over the leg affected, of a red colour, and filled with bluish-coloured water. When the skin bursts, it leaves below it a loose flabby substance, of the same colour, or rather darker, which extends even to the bone. It generally first begins in one of the hind legs, but as it advances affects all the four, unless death takes place before this happens. It spreads occasionally from the hind legs to the belly, and in every case the kidneys are affected, being loose and flabby, having some resemblance to the swelling of the legs, and being sometimes of a livid colour. Sometimes the disease proves very quickly fatal, and at other times will continue in a milder state for weeks. It spreads very rapidly after appearing in a flock, and if not attended to will injure them materially. It is in general very dangerous, cutting off the greater proportion of those affected. Indeed, many of the farmers kill the affected sheep whenever they observe them, to prevent its spreading. In this disease the eye of the sheep is languid, its tongue dry, it cannot eat, and in general is soon cut off.

"It appears commonly in July and August, at times in September; arising at first from sheep of unhealthy constitutions being exposed to wetness during rainy and warm weather. Scratches in the legs will produce it in those whose constitutions are bad. If the sheep get their legs dirtied during clipping, or smearing in a house where there is much dung, they will readily be affected with it. Boggy ground has also a tendency to produce it, from the same cause.

"As this is a very dangerous disease, the sheep affected should be brought home as soon as possible, to prevent it from infecting the flock; and its legs well washed with soap in water; afterwards bathed with lime water, or a solution of alum in water; and then anointed with what in the shops is known by the name of *citrine* ointment, made with mercury dissolved in aqua fortis, and mixed with hogslard. If this is not at hand, when the legs break out and run, a little quicklime may be dusted on the sloughs, and the leg dressed with a cloth, spread with fresh butter and a little tar. These should be changed every second day; care should be taken that the sheep have good and dry pasture during the time of the cure; and water, in which moss has been steeped, may be preferred (on account of its antiseptic quality) to common water, for their drink, and for washing the legs.

"After clipping, or smearing, in grounds subject to this disease, driving the flock through a pool or river, so as to wash their legs, is a very proper practice, and clipping the hair short upon them prevents any dirt from lodging on them.

"A disease somewhat similar to this, and affecting the tail, has been denominated

"*Tag.*—It consists of scabs and sores, situated on the under side of the tail, arising in warm weather from its being fouled with purging. The matter hardens there, irritates the tender vessels, and produces sores; which, if not attended to, run into mortification, and prove fatal, as in the legs. It is observed by the sheep turning frequently round to bite the tail.

"As this complaint arises from purging, the first thing to be done is the cure of this. (See *Purging.*) Then the tail is to be clipped, and the sore part laid bare, washed carefully with milk and water, blood warm, and then with lime-water. Turn out the sheep into a dry pasture, and look at it again in two days, and if not well, repeat the washing, and anoint it with grease and tar mixed together, in equal proportions. Doing this twice, is generally sufficient for completing the cure." Mr. Stevenson.

Vermin.—The ked *(hippobosca ovina)* molests all sorts and ages, but particularly hogs or young sheep, and chiefly such as are lean. It harbours in the wool, bites the sheep, and sucks their blood. Smearing with tar expels it from the skin, and it soon afterwards drops from the wool. Tobacco juice is fatal to the ked almost instantaneously, and mercurial ointment destroys it.

The tick *(acarus reduvius)* is a distinct species of vermin, harrassing the lambs and trembling sheep in spring. It always adheres close to the bare spots of the shoulders, thighs, or ears, draining the blood. For the most part it drops off in June. It is removed by the same remedies as the ked, but it is prevented by having the young sheep in good condition.

For the fly, the sheep powder, or unslacked lime, is the best cure.

Maggots are troublesome in August, when the season is warm. They are the brood of the flesh or sheep-fly

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(œstrus ovis), which deposits her eggs in any filth adhering to the skin, or any wound or sore. There the eggs are soon hatched, and the maggots eating and penetrating in every direction under the skin, cause intolerable pain, and even kill the animal, if not removed. When sheep, therefore, are observed to be uneasy and harrassed, to frequent rubbing places, neglecting their food, to lie down frequently, and to bite themselves with their teeth, they should be examined carefully: when large blisters will be found, under which the maggots are concealed; or the part is of a dark colour, and quite wet, or large holes are already eaten into the body of the animal. The wool must be carefully clipped off, the blisters, if any, opened, and the vermin picked from the infected parts, which are to be gently washed with soap and water, or spirits and vinegar, or lime water, or stale urine and black soap, or infusion of tobacco, and anointed with tar, or tar mixed with butter, or sulphur, or red precipitate. After this the animal soon recovers. As a preventive, whenever the animal is wounded by the sheers in clipping, by the bite of a dog, or any other accident, a little tar liniment should be applied. Dirty layers are apt to produce this kind of vermin, which most commonly attacks lambs, and frequently appears about the hips of those which are affected with looseness. This, however, is not always the case, and Mr. James Hog says that it is easy to discover, while they are still clean, those that will become infected, from the noxious smell of the excrement, occasioned, in his opinion, by some kind of food, or a certain habit of body.

Jaundice, or Head Ill, or Yellows *.—Jaundice is not a common disease among sheep, and has not been very accurately described, so that it is highly probable that several affections are confounded under the various appellations given to it. I shall, therefore, not attempt to reconcile their accounts of it, but quote separately the descriptions of each author by whom it is mentioned.

"This is not a common disease, and is generally confined to the South Down and Leicester breed, which, from their more tender constitutions, are more subject to complaints.

"The symptoms are, a yellowness over the body, which is particularly observable in the white of the eye. The wool has a little also of the tinge, and is slightly hard. The passages of the belly are of a whitish colour, and the urine tinges of a yellow hue any thing immersed in it. Sometimes there is a degree of fulness and hardness in the right side, where the liver lies.

"The causes are by no means apparent; their effect, however, seems generally to harden the liver, and invariably to obstruct the passage of the bile from it into the intestines. Sometimes small stones, formed in the gall-bladder, produce this; and at other times, as in rot, by the swelling of the glands, impeding the passage of the bile, jaundice is produced, in which case it is generally incurable.

"The cure of jaundice is to be attempted by strong purgatives, and such medicines as act strongly on the stomach. A solution of three ounces of Glauber's salts will partly tend to produce this. Ten grains of ipecacuanha, given every three hours, in a little warmed strong beer, is said to be attended with the most beneficial effects, when continued for five or six days, and a dose of Glauber's salts given after it, so as to clear the bowels. I never had an opportunity of seeing jaundice but once; in which case the disease had gone on for some time, without being observed, or even suspected, till the yellowness of the fat and flesh was observed after slaughter, which effectually prevented its sale: thus proving a loss to the butcher, who never observed it." Mr. Stevenson.

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* Jaundice, Mr. Stevenson. Yellows, or Jaundice, Mr. Singers. Yellowses, or Jaundice, Mr. Scott. Yellow Sickness, or Jaundice, Mr. J. Hog. Yellowses, or Headswell, Mr. Beattie. Head ill, Mr. W. Hog.

"There is another rare distemper, called the *yellow sickness*, which I do not at all consider as a species of the braxy, but rather a sort of jaundice. They pine in it for some days, and are very sick. The entrails, on dissection, are of a dark yellow, and have likewise a smell peculiar to that distemper, flavouring something of sulphur. But this is a disease peculiar to old sheep, and, had it not been for the name, ought not to have been mentioned under this head (viz. *Sickness*). Such sheep as feed on woody banks are most subject to it; and I always consider it as proceeding from their eating some poisonous herbs. There is always a sort of congealed stuff, like rotten eggs, about the kidneys." Mr. J. Hog.

"Old sheep are sometimes affected with the yellows, or jaundice, at different seasons, but chiefly in harvest, and in mossy pastures. The whole body puts on a yellow hue, and even the tallow is of the same colour, when the body is opened after death. The distemper, from the period of its giving the yellow hue, is soon at a crisis, being fatal commonly in twenty-four hours, or within that period. It is not a common disease.

"Obstruction of the bile appears to be the immediate cause of the yellows. When that liquid ceases to pass into the intestinal canal, the digestion of aliments and separation of chyle do not go properly on. The bile also takes a new course, and contaminates the animal system.

"What it is that causes these obstructions we do not certainly know. The putrid miasmata of stinking water, or the water itself taken into the stomach, are suspected: so likewise are poisonous insects, or plants. The liver, being the organ that secretes the bile, whatever disorders that organ may affect this fluid in its nature, quantity, or courses; an incipient rot, that injures the liver, may therefore be capable of taking a new turn, obstructing bile, and bringing on the yellows. It is possible also, that sand, or calculi, may produce this effect.

"The most promising means of cure, are solutions of salt in water, which tend to promote the regular secretions. Some recommend sulphur in warm milk, or saltpetre in common water, bleeding in the tail at the same time, and causing the sheep to move, and keep itself warm. If these things do not appear to give relief, it is then recommended to kill the animal, and to draw off the blood. The carcase is said to be less injured than in sickness. Yet I should doubt the propriety of allowing it to be eaten, if highly tainted with bile; for I know the gall of a sheep, swallowed entire, proved a mortal poison to one of those large and powerful greyhounds that were once carefully reared in the Highlands for hunting down the hart and hind.

"As the jaundice appears chiefly in mossy pastures, and towards latter harvest, we have another evidence of the impropriety of confining stocks to that wet soil so late in the year. If poisonous animals are concerned in bringing it on, I know no remedy so efficacious against them as burning the rough herbage at the proper season. Moss holes are not easily rendered putrid; they differ extremely in this respect, from holes in clay, which exhale noxious vapours in immense quantities. Yet the waters of moss may become corrupted; and being otherwise dangerous, they should be drained off. Sheep may be safely, and to great advantage, pastured in drained moss, free of these holes, in Spring; but being then weak, they might readily fall in, and be lost in holes.

"I have often suspected the bite of adders as the cause of jaundice in sheep. In this case vinegar should be applied, and put down its throat. I knew this relieve a man in that state, by his throwing up directly an immense quantity of bile." Mr. Singers.

Mr. W. Scott briefly notices, that it is not common, but dangerous, that the whole body is swelled, and that good effects arise from cutting off the ears entirely, and the tail by the middle.

Mr. Beattie mentions, that there is a great swelling and falling down of the ears, and that when too long neglected the head swells, and the sheep dies. The flesh is yellow. It is often cured by cutting off the ears, cropping the tail, or opening the veins under the eyes in time.

"The *head ill* is the next disease we shall take notice of. I cannot apprehend that this disorder is radically in the nature of either sheep or soils, I rather think it is an adventitious evil, caused by the bite, sting, or influence of some venomous animals: for proof of this, I may observe, that this disease is most frequent in those parts, where such reptiles are known to abound. The sheep, unapprehensive of danger, comes nearer the lurking-place of the fierce animal * than it wishes it to do; the enraged creature flies at it in a moment, and by biting, stinging, &c. communicates its malignant nature: instantaneously the head swells, the tongue and gullet inflame, and turn black; the extraordinary swelling soon obstructs respiration. Perhaps in this condition it lives a day or two, then dies; doubtless in great agony."

"Of the same nature, and from the same cause, proceed the inflammation in the belly, udder, &c. that is so frequent in the summer months. The best thing that can be done for sheep in these circumstances is rubbing and soaking the infected part with Norway tar."

Dropsy.—Dropsy in sheep is rather a symptom of other diseases than a disease itself. In different degrees and forms it is incident in all the varieties of soil and climate, from Shetland, where it is called the Shell sickness, or Water sickness, to the south of England. In general aged sheep are most subject to its attacks, chiefly towards the end of harvest and winter, and on farms destitute of shelter. Indeed, it is the genuine offspring of cold and moisture. Its symptoms are swelling in the legs at night, which disappears in the morning, when the lower jaw is a good deal swelled. The eye is dull, urine, when observed, is high coloured, the tongue is dry, and when the disease advances the belly becomes tense, and water is felt undulating in it, on being struck with the one hand, when the other is kept steady in the other side. The sheep loses heart and appetite, becomes lean, and at last falls.

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* Among the venomous creatures that hurt sheep in this place we generally reckon the adder, snake, slow-worm, and a large kind of asps, that haunt woods, warm parts.

A dry sheltered walk is a good preventive, and sea-shores are found, by experience, to be useful in this distemper. But if it should appear with severity in very wet seasons, in winter or spring, night shelter is of particular importance to stop the increasing evil.

A shade, or house-room, and an allowance of dry hay, should be given to those which are diseased. Mr. Stevenson has seen tapping tried, but the relief was very temporary. In one case two drachms of cream of tartar given twice a day, in a little warm water, had a remarkably good effect. But, upon the whole, he considers it the best plan to kill the animal as soon as the disease appears, as it never affects sheep in health, but reduces them daily.

Blindness.—Certain parcels of sheep are very subject to blindness, and although it is not a fatal disease in itself, it frequently occasions considerable loss by their drowning themselves, or breaking their necks. It is occasioned by a white film growing over their eyes, in consequence of inflammation, probably of different kinds, at least arising from different causes.

According to Mr. Stevenson, "the symptoms that first appear are: the animal cannot bear the light, and the white part of the eye is red and inflamed, and it waters a great deal. This is succeeded by a membrane formed by the inflamed vessels, which first covers the white, but gradually extends over the eye, till total blindness ensues. This is observed to have taken place, when in folding, they run against dykes, or any other obstacle, and start when they approach it; they do not follow the flock, and frequently stumble. When the eye is inspected, it is generally found, that a blue slough covers the whole of the eye, without any intermixture of red vessels. In the worst cases the coloured and transparent part of the eye becomes of a reddish white, by which time the film on the eye has acquired considerable thickness."

The inflammation is produced by various causes. In summer it is ascribed by Mr. Stevenson to the reflection of heat and light in very sunny and dry weather, as it is more frequent when the hills become scorched, and on hard rocky soils, than on dark-coloured hills covered with heather. The Rev. Mr. Singers thinks that it is sometimes caused by the pollen of flowers irritating their eyes, when blown into them in considerable quantities. In winter blindness occurs, when the days are very sunny, and the evenings frosty and cold, or when sheep have been long buried under snow, and the ground is still white when they get out.

Mr. James Hog ascribes the blindness of sheep to a cause totally different from any of these. It is therefore proper to quote his description entire. "It is occasioned by a continued fatigue for a length of time, which will bring it on at any season of the year. Thus sheep that are long and hard driven, or such as are daily dragged from one part of the ground to another; ewes that are eild, and roughly used by the women during the time they are milked, and hogs which are fatigued by driving through snow, to preserve their subsistence, are all subject to it. Their eyes at first become sore, and emit a sort of ropy humour; after which a white a white film settles over them, and if they continue to be fatigued it grows thicker, and the eye appears perfectly white; in which case they are proportionably longer of mending. For this, some bleed them below the eyes, and let some of the blood run into each of them; but the enjoyment of ease will infallibly cure them in a space of time, proportioned to the fatigue which they underwent before."

Where blindness is like to be produced by the pollen of flowers, the sheep must be removed to some other pasture, where they are less abundant, till all the antheræ have exploded; and in cases of snow-blindness it is proper immediately to bring them down from the snowy walks to bare grounds.

Besides the remedies mentioned in the quotation from Mr. J. Hog, Mr. Stevenson advises the inflamed vessels on the white of the eye, especially those next the nose, to be cut with a sharp penknife every second morning, while the eyes are to be defended against the light by a shade tied over the head, or a piece of crape over the eyes. The eyes may be also bathed twice a day with a solution of half a drachm of sugar of lead, or of two drachms of alum, and two of white vitriol, in a mutchkin *(English pint)* of water. Internally purgatives may be given, such as two ounces of Glauber's, or common salt, or ten grains of sweet mercury, once a day, for four or five days. When these remedies have got the better of the inflammation, but the slough still remains, a little ointment, composed of eight parts of basilicon and one of red precipitate of mercury, may be inserted every morning, or a little powdered crystal and loaf sugar blown into them twice a day.

ACCIDENTS.

Rolling awald.—Sheep are most apt to die awald when it grows warm after a shower, from the beginning of May, till they are shorn. They lie down, roll on their backs, to relieve the itching there; and if the ground happen to be level or hollow, or if they be weak, heavy with lamb, fat, or full fleeced, they are often unable to get up, and soon sicken, swell, and die. The flesh of sheep which die awald resembles in taste, colour and smell, that of sheep carried off by sickness. When a sheep is observed in this situation, the shepherd should lift it up, and the afternoon is the best time for him to make his rounds, and see that all is right.

Drowning.—"Sheep sometimes drown in soft mossy land, and at other times in places where people have cut their peat fuel. In former times the cutting of these peats was often carried on in a very improper way. On a surface of not more than three or four feet square, three deep, peat used to be cut, making a pit more than four feet deep. These pits were filled up with water. In dry weather sheep come and drink of this water, which gradually diminishing by a continuance of drought, occasioned their stretching farther into the pit for it, and the consequence was, that they often stuck, and were drowned. I have a concern myself in a farm, where, upon my entrance to it, many such pits were found. I saw it necessary to make outlets for the water, where it could be done, and break down the turf upon each side, so as to fill up the pits, and remove the possibility of any stagnating moisture in time coming. The sheep can now pasture upon every part of the farm with all freedom. When peat-cutting is performed with care, so as to prevent all danger to sheep, and all waste of pasture, openings are made for the water; only one foot deep is taken; the surface turfs are carefully laid aside, and after the peats are taken out these turfs are brought back one by one, and placed upon the part that was made bare. This operation is called *shoeing the moss*, and the grass is scarcely ever stopt from growing." Mr. Welsh.

Accidents in smearing.—"It is dangerous to lay on too much tar. There is also a species of tar that proves acrid, blisters the sheep, causes the wool to fall off, and sometimes proves fatal to them. This tar is more dangerous for tups than for other sheep; probably because the tar runs quicker on the skin of a tup, and his temperament is warmer. I have been informed of several tups dying in one night after being smeared, without the loss of any other sheep, although the tups were laid fully as light. I know also, that laying on much tar, or mingling it in great proportion, has been hurtful to some sheep, and fatal to others; when the same tar, laid on lighter, and with more butter, did no sensible injury to other stocks. When the tar is thin, and appears black on stirring it, and when the smell is offensive, and the taste caustic or acrid, it should never be used for sheep, unless there be an absolute necessity, when it ought to be boiled a little, before mingling, to dissipate the caustic parts. The component parts of tar, which is obtained by fire from the fir, are, by Dr. Thomson's account of it, oil, resin, water, and pyroligneous acid. It can only be this last ingredient that can prove caustic and hurtful to sheep: the pyroligneous

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nous acid consists of acetic acid, and empyreumatic oil, so called, as being formed by fire; and all this class of oils are of an acrid taste. The pernicious ingredient, together with the watery part, may be dissipated so far by fire, in boiling the tar. The smearers often find proof of the danger of this acrid tar by its burning effects on their fingers; and, as a general rule, it should be rejected.

"Good smearing tar, on being stirred, appears thick, brown, and ropy; and has also a more pleasant smell, and less acrid taste, than the other." *Mr. Singers.*

Accidents in shearing the sheep.—"There is sometimes a degree of danger in the slightest mark of the wool-scissars, for which the shepherd is at a loss to account, the part very quickly running to inflammation, followed by mortification and death. At other times these marks heal up more kindly. It will be sufficient to mention the known causes of this danger. The sultry state of the air is suspected; flies are dangerous, by infesting the wounds, and causing them to spoil; on which account the clipping should be at some distance from houses or dunghills, and even from cow dung in the fields. Care should also be taken to allow them clean airy pasture after the operation is over. And in performing this operation, the ointment used for any accidental mark should rather be a mixture of bees wax than of tar in the butter; or if tar be employed, it should be good of its kind, and well boiled, to make it firm in the wound." *Mr. Singers.*

TO BE CONTINUED IN OUR NEXT.

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List of Patents for Inventions, &c.

(Continued from Page 216.)

John Brierley, of River Bank, in the county of Flint; for a new mode or process of setting blue lead, for corroding the same into white lead. Dated January 17, 1809. Specification to be enrolled within one month.

James Goddart, of Newman-street, Mary-le-bone, and county of Middlesex, Gentleman; for a method of, and machinery for, manufacturing a certain description of wooden boxes, called chip boxes or pill boxes, of all the various sizes and shapes hitherto made. Dated January 23, 1809. Specification to be enrolled within one month.

Edward Stracey, of Parliament-street, Westminster, Esquire; for an improved method of hanging the bodies, and of constructing the perches, of four-wheel carriages, by which such carriages are rendered less liable to be overturned, and of constructing perch-bolts and collar-braces. Dated January 23, 1809. Specification to be enrolled within one month.

John Peck, of Charlotte-row, Fort-place, Bermondsey, in the county of Surrey, Millwright; for a machine for casting printing types, by which three motions out of five made in the ordinary method of casting types are saved. Dated January 23, 1809. Specification to be enrolled within one month.

Samuel Whitfield, of Church-street, Birmingham, Brazier and Scale-beam-maker; for a method for the application of stamps, dies, and piercing tools, to the manufacturing of ears, handles, and bevells, for culinary articles of every description, whether in wood, iron, brass, copper, tin, silver, or any mixed metals. Dated January 23, 1809. Specification to be enrolled within one month.

MICHAEL LOGAN, of Rotherhithe, in the county of Surrey, Civil Engineer; for a transcendant ordnance or improved cannon, for either marine, fort, or field service. Dated January 26, 1809. Specification to be enrolled within six months.

ANTHONY GEORGE ECKHARDT, of Berwick-street, Soho, in the county of Middlesex, Gentleman; for a method or methods of casting metallic and other bodies, together or separately, in moulds, in the state of fluidity or softness, in order that the said bodies may preserve the figures thus obtained when they shall afterwards become solid or consistent by cooling, or by any chemical or other change, which shall or may take place, or be produced, in the nature, order, proportions, or quantities of the component parts or ingredients of the same. Dated January 28, 1809. Specification to be enrolled within one month.

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THE

REPERTORY

OF

ARTS, MANUFACTURES,

AND

AGRICULTURE.

No. LXXXIII. SECOND SERIES. April 1809.

Specification of the Patent granted to EDWARD STRACEY, *of Parliament-street, Westminster, Esquire; for an improved Method of hanging the Bodies, and of constructing the Perches, of four-wheel Carriages, by which such Carriages are rendered less liable to be overturned, and of constructing Perch-bolts and Collar-braces.* Dated January 23, 1809.

With a Plate.

TO all to whom these presents shall come, &c. NOW KNOW YE, that in compliance with the said proviso, I the said Edward Stacey do hereby declare that my invention is described in manner following, and by the drawings hereunto annexed; that is to say: This my invention embraces four objects, *viz.*

First. The constructing of the perch of a four-wheeled carriage in such a manner that either of the axletrees may have a vertical motion independent of the other, so that one axletree may remain parallel to the plain of the horizon, whilst the other is perpendicular to it, or, in other words, that the axletrees may be in different planes at the same time.

Second. The hanging of the body on the springs of such a carriage, in such a manner as will tend not only to diminish the liability of its being overturned, but add also to the ease of its motion.

Third. The forming of a collar-brace, which shall almost immediately bring the body to an equilibrium, should the centre of gravity be moved.

Fourth. The forming of a perch-bolt; by the use of which the carriage may be more easily turned to the right or left, and the friction that now takes place by the use of the common perch-bolts between the wheel plates, the transom bed, and the fore axletree bed, reduced almost to nothing.

Carriages constructed on my principle differ but little in appearance from other four-wheeled carriages; the chief distinction lying in the construction of the perch, and in its having a revolving motion, and in the hanging of the body on the springs.

1. The perch of my invention is formed of ash or other tough wood, or of iron, and may be of the same length and diameter as other perches are made; the size of the perch being proportioned to the strength required. The fore part of this perch is fixed to the transom bed in front, in the usual way, and the after-part of it, instead of being fixed in the hind axletree bed as usual, is so contrived that the perch has the power of a revolving motion in it, being connected to this axletree bed by a cylindrical box of metal, through which the perch passes at the junction of the perch wings, and then enters in the cylindrical box, made of metal, fastened in the hind axletree bed itself; in both which boxes the perch is allowed to turn freely; that part of it which works in the box at the junction of the perch-wings being

guarded with a collar of brass or other suitable metal, to reduce the friction; and that part of it which works in the box in the hind axletree bed, being a cylindrical axis, made of iron or other tough and hard metal (something resembling the arm of a common axletree) fixed at the end of the perch, and secured in that box by a strong nut, screwed on to the end of the axis. The diameter of this axis may be from one to two inches, or more, as necessary. The box at the junction of the perch-wings should be placed immediately opposite to the centre of the hind axletree bed, so that a straight line passing through the centre of that box would also pass through the centre of the box in the hind axletree bed. This axis of the perch working in the hind axletree bed as above described, may, if required, be made to work in a similar manner in a box fixed in the hind spring bed. (See drawing, Fig. I, Plate XI.) The internal parts of these boxes, as well as all the other parts where any friction takes place, should always be kept well greased. The perch being thus allowed to turn on its axis, the fore axletree bed may have any degree of obliquity required, (provided the body is not hung on the carriage), from the plane of the horizon given to it without affecting the horizontality of the hind axletree bed, and *vice versâ* (see Drawing, Fig. 1.) and it is by the instrumentality of this motion co-operating with the mode of hanging the body on the springs, and by the aid of the collar-braces, hereinafter to be described, that the body of the carrriage may be kept nearly on the true level, or at least sufficiently so as to prevent its being overturned, although either the fore or the hind axletree may have a great degree of obliquity from the plane of the horizon. It is evident that a similar effect and security may be obtained by inverting the construction of the perch above described as by having the fixed part of the perch in the hind axletree bed, and the revolving part in the transom bed in front, or by making the perch revolve on an axis at each end, or by any other mode which will allow the hind and fore axletree beds, when connected by means of a perch, to be in different planes at one and the same time, as by permitting one axletree bed (provided that the body is not hung on the carriage) to remain parallel to the plane of the horizon, and by making the other stand perpendicular to it (see drawing Fig. 1).

2. I shall next proceed to describe the mode of hanging the body on the springs, as being, in point of importance, the second essential to my method of constructing carriages; for in consequence of this power of motion, above described, given to the axletrees independently of each other, it is necessary to adopt a mode of hanging the body different to that at present used, in order that the main braces may accommodate themselves in a certain degree to the motion of the axletree (by allowing them materially to change their planes without much affecting the level of the body). To effect this, the body is to be hung on springs, which may be upright, C, whip or other springs acting in a similar manner, and affixed to the carriage in the usual mode.

The principal variation of my patent invention from the common method of hanging the body on its springs consists in the body loops, which must be so extended that the ends of them may come nearly under the shackles of their respective springs, and each of them so formed as to end in a cylindrical axis of one to two inches or more in length, and of sufficient strength to support the body; and on each of these body loop axes, a shackle, for the reception of one of the main braces, should be fitted, ending in a cylindrical box or socket, made so as to work and turn on the axis of the body loop, and secured to it by a nut and pin; and the connection between these shackles and their respective boxes or sockets should be by means of a strong joint, working towards the front and hind part of the carriage in the direction of the perch, and the shackles should be of such sufficient length, that when working or falling towards their respective springs, they may be able to work or fall entirely clear of their respective body loops; and these axes and joints should always be kept well greased (see drawing Fig. 2.). The body is then to be hung by the main braces attached to these shackles on the springs in the same manner as other carriage bodies are usually hung. When the body is thus hung, the action is as follows; should either of the hind or fore wheels descend into a low spot in the road, or ascend a raised surface, the boxes or sockets on the body loops will turn on their axes nearly the tenth of a circle, and to that inclination will the body, with the co-operation of the collar braces, hereafter to be described, be enabled to preserve its equilibrium sufficiently, so as not to be overturned. Thus, to a certain limit, my invention is calculated to prevent the overturning of carriages on four wheels, and at the same time to produce greater ease in their motion. (See drawing, Fig. 2). This mode of hanging the bodies of four-wheeled carriages, may be applied generally to all such carriages as have upright, C, whip, or any other springs acting in a similar manner, whether the perches of such carriages are or are not formed and constructed in the manner above described, and

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and such method will greatly add to their ease and security.

3. The next object is the collar brace, invented by me, which is thus formed: a cylinder or roller, made of metal or wood, or other substance sufficiently strong, being in diameter about two inches and a half, and in length about three inches and a half, has an axis made of iron, or other suitable metal, passed through and fixed firm in its centre, and projecting about half an inch at each end of the cylinder or roller, the axis being supported at each end by an upright piece of metal or wood (being standards for the cylinder or roller), fastened on the perch at the place where collar brace rings are usually fixed, on which standards the axis is allowed to turn round freely, being always kept well greased (see drawing Fig. 3), and then over or underneath this cylinder or roller, when thus fastened on the perch, let a strap proper for a collar brace, be conducted from a collar brace ring, (to which such strip is attached,) fixed opposite to the cylinder or roller, under the right hand or off side of the body; which strap is to be drawn tight, and screwed on the opposite side of the cylinder or roller; and then over or underneath this cylinder or roller let a similar strap be conducted from a collar brace ring, (to which such strap is attached,) fixed opposite to the cylinder or roller under the left hand, or near side of the body; which strap is to be drawn tight, and screwed on the opposite side of the cylinder or roller. If the straps are attached to the collar brace rings by buckles, they may be let out, or taken in, as necessary. The diameter of the cylinder or roller must be proportionate to the motion it is desired that the body should have to the right or left; and the length of the

cylinder or roller must be proportionate to the breadth of the collar brace intended to be applied; and the height of the standards must of course be proportionate to the diameter of the cylinder or roller it has to support, so as to admit the collar-brace strap to move easily between the cylinder or roller and the perch. This cylinder or roller may also be affixed, if thought proper, on the body underneath, and just over the perch, with one end of each collar brace strap affixed thereto, as above described, and the other ends of the strap affixed by rings as usual to the perch, and may be applied to all carriages.

My invention is therefore the application of this cylinder or roller generally to the collar braces of carriages. By means of this collar brace, should the centre of gravity of the body of the carriage be moved by any inequalities in the road or otherwise, either to the right or left, the equilibrium will be almost immediately restored by the motion of the cylinder or roller on its axis, and the consequent lapping and unlapping of the straps, for to whichever side the body is impelled, on that side will the collar brace be lengthened, and of course the opposite collar brace proportionally shortened; one side is made to operate as a check upon the other, in order to bring the body to its true centre.

The fourth and last object is the perch bolt of my invention, which is made of iron, or other tough and hard metal two or three inches shorter than the common perch bolt, and the diameter proportioned to the strength required; round the centre of this perch-bolt a collar of iron projects a quarter of an inch or more from the surface, and about an eighth of an inch in thickness; and on the upper side of this collar or projection to the upper extremity of the bolt is formed a right hand male screw, the threads of which may be from an eighth to a quarter of an inch apart, and on the lower side of this collar or projection, to the lower extremity of the bolt, in like manner, is formed a left hand male screw, the threads of which may be from an eighth to a quarter of an inch apart, (see drawing A, Fig. 4), care being taken to proportion the strength of the threads of both screws to the weight they have to carry. To this perch-bolt are to be adapted two female screws or taps, made of iron, or other tough and hard metal, one for the right hand male screw, and the other for the left hand male screw (see drawing B, Fig. 4.) The flanches of these female screws or taps are then to be sunk and bolted, one into the under part of the transom bed, and the other into the upper part of the fore axletree bed; the perch-bolt is then to be screwed, each male screw into its proper female screw or tap, and the bolt turned round until screwed perfectly tight, and the fore axletree bed brought parallel to the hind axletree bed. When the perch bolt is thus properly placed and well greased, the fore axletree bed may be turned either to the right or left, with much greater ease than if the common perch-bolt were made use of, the usual friction between the beds and wheel plates being almost wholly removed, from their being gradually separated by the lifting of the screw in the act of turning. And another advantage gained by this construction of the perch-bolt is, that the transom bed being thus screwed to the fore axletree bed, the motion of the carriage will be more steady. This perch-bolt may be applied in general to four-wheeled carriages of all descriptions.

In witness whereof, &c.

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Fig. 1.

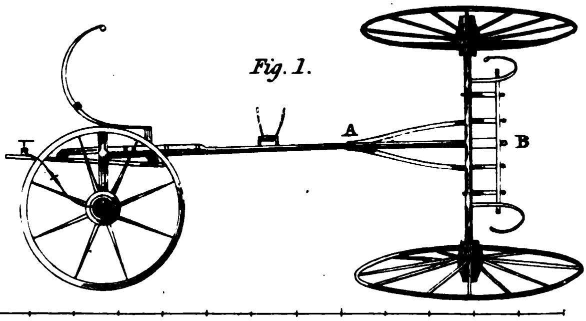


Fig. 3.

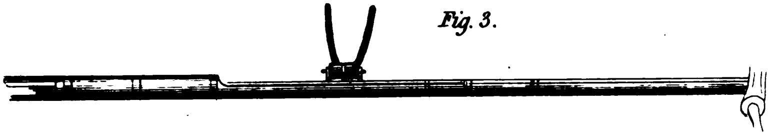
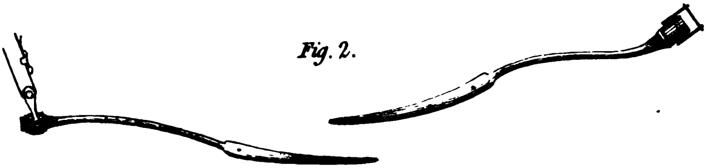


Fig. 2.



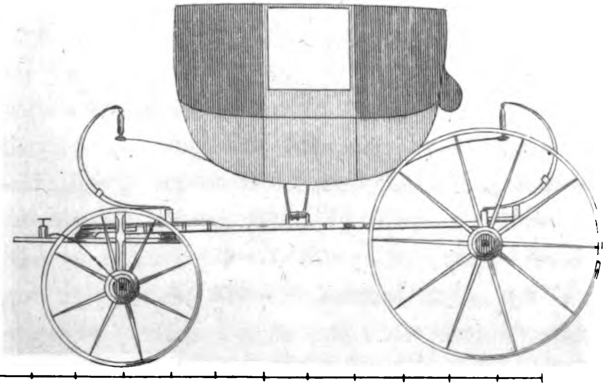
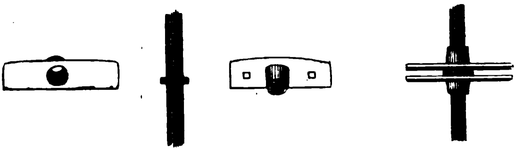


Fig. 4.



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Specification of the Patent granted to THOMAS JONES, *of Bilston, in the County of Stafford, Japanner; for Compositions for the Purpose of making Trays, Waiters, and various other Articles, and new Modes or Methods of manufacturing the same, that is to say, by Presses or Stamps.* Dated March 23, 1805.

With an Engraving.

TO all to whom these presents shall come, &c. NOW KNOW YE, that in compliance with the said proviso, I the said Thomas Jones do hereby declare that my said invention is made and manufactured in the following manner, and of the materials and ingredients following; that is to say, for small articles, I take one hundred pounds weight (more or less) of rope, and twenty pounds weight (more or less) of rags: and for large articles, I take one hundred pounds weight (more or less) of rope, and ten pounds weight (more or less) of rags, and I reduce them to a pulp in water, or any suitable liquid, by bruising, beating, cutting, or grinding, or in any other way that will answer the purpose: and after the materials are thus reduced to a pulp, I put to it as much vitriol or other acid as will make the whole mass a weak acid; but it will do without any acid, but I conceive not so well. This is one composition which I use. For another composition, I take fifty pounds weight (more or less) of nettles, and dry and hatchel them, and mix them with fifty pounds weight (more or less) of rope, and I reduce them to a pulp as before described; but the former composition I conceive to be best, but compositions may be produced or made various ways, by using ropes alone, or rags alone, though I conceive they are better mixed or by adding to or mixing with either or both of them about a third part of dung, hurds, nettles, or any other animal or vegetable substances, or any-kind of articles which will felt; or they may be made of other materials, such as flax or hemp, or flax and hemp mixed, or waste paper, nettles, or those articles mixed with other articles that will felt. To collect the composition or pulp so as to make any article I wish, I take a wire sieve, or any other kind of sieve, of or near the shape of the article I intend to make, with a frame of the same size, and deep enough to collect a sufficient quantity of the composition or pulp, which, when pressed or compressed by the after mentioned stamp or press, will make the article I want thick enough, or in one solid mass, without pasting or adding thereto; or the composition or pulp may be collected in any other way that may answer the purpose, but I conceive sieves to be best. I then put the frame A (Fig. 1, Plate XII.) upon the sieve B, which are intended to collect the composition or pulp for making an oval canoe; and when a sufficient quantity of the composition or pulp is collected in the sieve and frame, I put on a flannel or woollen cloth, or any other proper cloth or material, and upon that a board or other material, and then turn the pulp out of the sieve and frame upon the flannel or woollen cloth, &c. and put another flannel or woollen cloth and board, &c. upon the top of it, and press the same together lightly, to force out part of the liquid, and thereby make the pulp felt. I then take off the boards, &c. and put the composition or pulp (or it may rather now be called the felt), or composition still remaining between the flannels or woollen cloth, &c. as it then is between the herein-mentioned dies or tools, of the shape or form of the articles I want to make, and put the dies or tools, with the felt or composition contained therein, into the stamp or press, or by putting the felt or composition between the dies or tools when the said dies or tools are within the stamp or press, and press it till it becomes solid, and formed into the shape I want; when it has lost nearly all its liquid, I take it from between the dies or tools, and take the flannels or woollen cloths, &c. from it, and put it into a stove or oven, of a moderate heat, well known to japanners, where it remains till it is nearly dry: it is necessary to be cautious not to suffer it to get too dry, or it will be liable to break when put between the dies or tools again. When it is almost dry, I take it out of the stove or oven, and put it between the dies or tools again, with or without the flannels or woollen cloths, &c. the dies or tools still remaining in the press or stamp, and press it with some violence, so as to set it and make it smooth. When that is effected I put it into the stove or oven again, and let it remain there till it is quite dry. But in drying care must be taken to prevent the articles warping, which I do by a frame made in the form of the inside of the article, with any sufficient weight to keep it in its proper form, or with blocks to fit the articles, with or without weights, or in any other way that may be found to answer the purpose. I then, if necessary, hammer them all over until I make them smooth and flat. I then make a dip or compound liquid, in any of the usual ways, well known to japanners of paper articles, and I put the articles I have made, being perfectly dry, into the dip or compound liquid, the liquid being previously made warm; or it may be used cold, but I conceive warm to be best; and let them remain till the dip or liquid has penetrated through them. I then take them out of the dip or liquid, and put them into the stove or oven, and let them remain there till they are quite dry. When the articles are quite dry, they will be ready to receive the usual varnish preparatory to rasping, filing, floating, plaining, &c. or what is generally termed skimming or finishing the blanks, or they may be skimmed, &c. previous to varnishing. The dies or tools which I make use of in working or manufacturing these compositions are entirely new as applied to the purposes herein mentioned, and I make them of such forms as will correspond with the shape or pattern of the article intended to be made, (see the drawings of the dies or tools for making an oval canoe, C female die, D male die), and which dies or tools I make of wrought iron, cast iron, tin, or any metal, semimetal, or composition of metals, or wood, stone, clay, stone earth, or composition of earths, or any substance or substances whatsoever, which may or can answer the purpose; but the method or plan I adopt, is having one of the dies or tools cast iron, and the other tin, or some other soft metal; and the plan I adopt to press the liquid from the felt or composition, and to give the articles I intend to make their proper forms or shapes, is by putting the dies or tools when the felt or composition is contained therein into a stamp or press, or by putting the felt or composition between the dies or tools when in the stamp or press; but though stamps or presses are what I use, yet the effect may be produced by leverage, or any other power sufficient for the purpose, which power or powers are new as applied to the herein-mentioned purposes. The use of these compositions is intended to be extended to the making or manufacturing of all kinds of tea-trays, sandwich-trays,

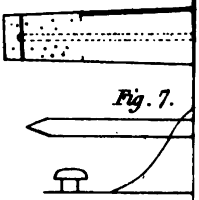


Fig. 7.

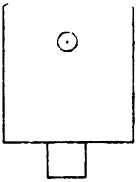


Fig. 9.

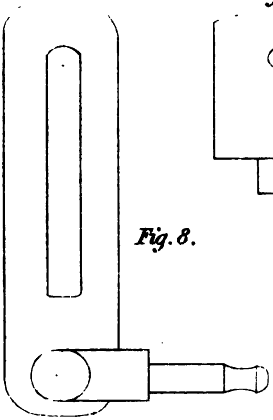
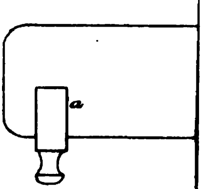
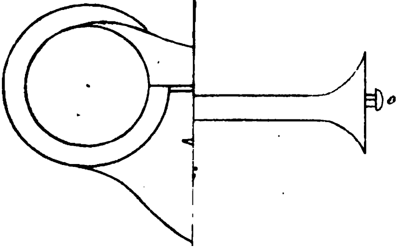
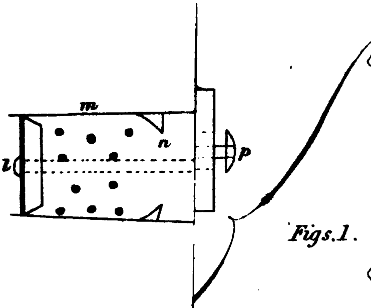
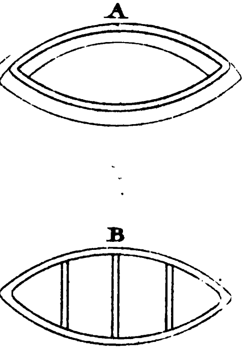


Fig. 8.









Figs. 1.

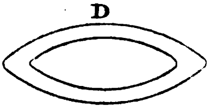
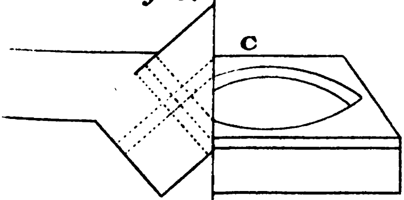


Fig. 15.



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trays, waiters, bottle stands, boxes, baskets, caddies, or pannels for any coach, chaise, or any other kind of carriage, tables, hats, caps, frames, &c. of any form or shape; and various other articles made or manufactured upon the above-mentioned principle.

In witness whereof, &c.

Specification of the Patent granted to EDWARD MASSEY, *of Newcastle, in the County of Stafford, Clock and Watch-maker; for an improved Cock for drawing off Liquors.* Dated September 24, 1808.

With Engravings.

TO all to whom these presents shall come, &c. NOW KNOW YE, that in compliance with the said proviso, I the said Edward Massey do hereby declare that my said invention is described and ascertained in and by the drawings hereunto annexed, and the following description thereof; that is to say:

Fig. 2 (Plate XII.) represents a cock with three valves; the first at A is of the same shape as Fig. 3, the funnel part and valve being thrown about a quarter of an inch out of the centre, for the purpose of admitting the other rods to pass up the middle. B is a stuffing box, to prevent its leaking out of the top: but it may be made with the same figure of a valve, and used without the stuffing box, by separating the axis from the valve, and making the point to press on the centre of it, as represented at *c*; the lever *d* being a fixture to the axis, and connected with the valve by means of the forks or claws *e*, and the convex spring *f* bearing up the axis against the shoulder *g*, upon which is fitted a leather collar, to prevent leakage; but if made with stuff-

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ing box, the spring must be reversed and applied against the shouldering *g*. H is the second valve, of the same shape as Fig. 3, and fixed vertically; a spring is introduced at the back of the valve, with its convex side bearing against it at *i*, and its extreme points having their bearing within the cock. The front part of the valve is a fixture, being of the same shape as Fig. 3. The object of the spring is to keep the valve together with a gentle pressure. Now it is evident, when two such figures as Fig. 3 are in the same direction, the passage will be open; and when one of them is turned a quarter of a circle by the lever or key at *j*, which is connected to the valve H by the tube *k*, it will be closed. L the third valve, which is represented as open: the liquor is to pass through the small holes at *m*: when the valve is shut it is drawn tight against its bearing at *n* by means of the spring, Fig. 4, which is attached to the elbow in the front of the cock, and turns on the centre at *o*. When the valve is required to be closed, pull it forward by the point of the rod *p*, and press the spring towards the cock, and pass the opening in it over the rod; the point of which being the largest, the spring will have a tendency to pull the valve forward in proportion to the strength of it. This rod passes through the centre of the tube *k*, in which there is a stuffing box at *q*, to prevent leakage in case of the inner valve not being perfectly tight. There is likewise a stuffing box in the lever at *r*, to prevent leakage in the front of the cock, so that the liquor may occasionally be under the security of three valves.

Fig. 5 is a front view of the lock of the cock, which, besides answering the ordinary purpose of the locking it, also locks it to the barrel, as hereafter described; *a* is the

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the lever, that turns the second valve at H, in Fig. 2; *b* is the staple; *c* is the hook, acting on a centre; *d* the spring; *e* is the stop; and *f* its spring: at *g* the key is introduced, which must be raised on its centre, so as to pass clear of the work in the lock, except coming in contact with the hook and stop, which rise a little higher than the other parts, and are opposed to the key. Now when the key is turned in the direction of the dotted arch, and the hook pressed out of the staple by it, raise the lever *a*, and the staple being a fixture, or part of it, it will be raised also, at which time the inner part of the staple which pressed down the ward or stop *e* into the dotted arch being likewise raised, the stop will rise out of the arch, and prevent the key from being taken out till the staple is returned into the lock, the object of which is to prevent the cock from being left unlocked.

Fig. 6 represents a bar, which is to secure the cock to the barrel.

Fig. 7 is a stud, which must be made fast to the barrel, in a parallel line with the top hole, and about two inches from it, which being done, the axis of the bar at *a*, Fig. 6, must be introduced into it at *a*: when done introduce the pin or screw *b*, which passes in a right line through the stud, and through the groove of the axis *a*, Fig. 6, which will prevent its being taken out of the stud till the screw or pin *b* is drawn out, which cannot be done without violence when the cock is in the barrel. Now, when the bar is fixed as above described, the cock must be introduced into the barrel, the bar being at liberty to move in a horizontal direction, and the side nut *c*, Fig. 6, being moveable along the bar, it will be easy to bring it so as to enter a screw into the nut at *b*, Fig. 6, through an upright hole in the lock at

k,

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k, Fig. 5, and by this means screw the cock tight to the bar. Now the lever *a* covers the screw when locked, by which means it is rendered as necessary to have the key to draw the cock out of the barrel as it is to draw the liquor. The lock may be applied to an horizontal valve, such as at *a*, Fig. 2, as conveniently as it is to the vertical one; but in that case, perhaps, it may be full as convenient to fix the bar vertically, and made as represented in Fig. 8. The nut or stud, Fig. 9, is secured to the front of the plate, Fig. 5, at about *i*, but is moveable horizontally on its centre, so as to form a line with the bar. But the lock is not now represented as having the plate attached to it, as in that case it would not shew the inner parts of it. The stud, Fig. 7, must likewise be fixed vertically about an inch above the tap-hole, so as the pin or screw *b* cannot be taken out when the cock is in the barrel. Now the screw must be passed through the groove in the bar into the nut or stud, Fig. 9, and screwed tight to it. The lever in this case must have a projection, so as to cover the head of the screw when locked, which will prevent the cock from being drawn, as before described, when placed vertically.

Having described the method of making a cock with three valves, and a method of locking it to the barrel, be it observed, that it is not necessary that all the valves should be used in the same cock, but may be made with one, two, or three valves, just as the mechanic or purchaser may think proper. If it is wished to use the inner valve *l*, Fig. 2, horizontally, as at *a*, it will require the stuffing box *b*, but no spring or shouldering to the rod, as in this case the valve must be drawn upwards, but may have a lever fixed on an upright, as at *a*, Fig. 10, to turn over the top of it when closed, which will likewise answer to lock it, as before described, in using the lock horizontally. If it is wished to use the valve Fig. 3 for an inner valve, it may be applied as represented in Fig. 11, with a spring at *a*. Again, if the valve *l*, Fig. 2, be used singly, it may be flung back by a crank, as at *a*, Fig. 12, but the axis should be flung out of the centre, so that the crank may act as near the middle as possible, and when closed, the crank being turned, the spring *b* will catch in the nitch, as represented at Fig. 13, and have a tendency to pull the valve forward. The valve, Fig. 14, may be substituted instead of Fig. 3, and the valve Fig. 3 may be used without the rim, whichever experience may point out as most advantageous, or they may be fixed obliquely, as in Fig. 15; but in all the above-described methods the liquor will have a tendency to close the valves.

In witness whereof, &c.

On combining Timbers for Ship-building, and on Planting. *By Mr.* CHRISTOPHER WILSON, *of Red Lion-street, Red Lion-square. In a Letter to Sir* JOHN SINCLAIR, *Bart.*

FROM the COMMUNICATIONS to the BOARD OF AGRICULTURE.

Sir,

AS you were so polite as to honour me with a request of my thoughts on the national advantages that would be derived in an agricultural point of view, in using small timber instead of large, or making large pieces of small, permit me first to present you with a copy of an extract from a long paper, which I delivered to General Bentham, with a model of a ship, and some drawings relating to the hull of a ship solely. Although the building of a ship is not immediately connected with agriculture,

ture, yet in this instance I think the mechanical and agricultural advantages are so interwoven as hardly to be separated.

The following is the conclusion of the paper on the mechanical part.

If the before-mentioned strengths produced by this plan should answer, the following important points will be gained by it.

First. By the increased longitudinal strength, a ship may be made to sail much faster.

Second. That by the lateral strengths a ship cannot work so at sea by rolling or in a heavy sea any way, and consequently not be in that danger of foundering, whereby many hundred valuable lives may be saved, as well as ships, when most wanted.

Third. If a ship built by this mode should get a-ground, she may come off again without receiving any damage; as a vessel so built will bear to take the ground in any direction with a much greater weight in her than she will be able to carry, as may be seen by the model; for a vessel of this construction will be the strongest at the surmark, or floor heads, where another ship is the weakest for taking the ground; for which reason ten ships may be saved where one is now, by getting a-ground.

Fourth. By the ship being clear between the guns, more guns may be fired in a given time than can be where standards or riders are in the way.

Fifth. As having no plank below the beams on the inside, the timbers will certainly last much longer, and the ships be ready in case of emergency, as the ships most proper for immediate service may be known by a slight inspection, and those that are not may sooner be made ready, and will ultimately be a great saving.

Extract of a subsequent Paper.

Suppose a tree to work eighteen inches square, fit for making a man of war's beam, will take 100 years to grow to that size, or to come to its full growth; and it will require three such trees to make one beam, and that one-third of that time will be sufficient to produce a tree of nine inches, and that three of the small trees will grow upon the same space of ground that one of the large ones will require.

If so, the result will be that twenty-seven small trees will grow in the same time, and same space of ground that three large ones require; and, as it requires three large trees to make one beam, it will require no more than six small trees, four to make the long pieces with the tops to the side, and two to be cut for the four short pieces; so by this mode twenty-seven small trees make four beams and a half, which to the grower of timbers, is equal to four crops and a half, instead of one, which will enable him to sell to the nation at a reduced price, and he be a great gainer, as will appear by the following calculation; and in my opinion the beams, &c. so made, will be much better.

Suppose an acre of ground in a century to produce 600, (I only take 600l. as a datum to calculate the advantages on,) by growing small instead of large timber.

Now allow an acre of ground by the small timber to produce four crops and a half in the same time, will be 2700l.; but if the grower sell at half that price, then he will have 1350l. to be paid at three periods, *viz.* at thirty-three years 450l. which with simple interest, although compound should be allowed, at the end of sixty-six years, he will then have, with the second payment added, 1642l. 10s.; and at the end of the 100 years, he will have 4802l. 12s. 6d. instead of 600l. By the above calculation, which I believe is right, the grower will get a clear profit, above what he now gets, of 4202l. and the consumer will be supplied at half the price he now pays; which will amount to an astonishing sum taken in the aggregate for 100 years, of all the large timbers which are now used for ship-building, mill-shafts, steam-engine beams, &c. and many other purposes which is not in my power to calculate, as not knowing the annual expenditure of large timber; but one thing is clear, that whatever is gained and saved by the grower and consumer, is a real source of national wealth, as it arises from the time and ground saved in raising timber fit for use.

If the mode of combining should be adopted, it may easily be promulgated by Government, through the Board of Agriculture, to the landed interest, to create a stimulus for them to plant, which will prove an inexhaustible supply of timber for the navy, and nation at large, as well as a great saving of expense: the calculation, which I think is a fair one, will point out the individual benefit, which in reality is a national wealth, as it is unconnected with foreign traffic.

I have omitted mentioning how much bark will be improved for tanning by being taken from young wood, as well as how agriculture may be benefited by new plantations, being properly managed with wood for hop-poles, and then for carts, waggons, ploughs, &c.

I now beg leave to explain my ideas on the latter part of the foregoing extract. In regard to bark, I believe it is generally allowed that the smoother, closer, and deeper bark is, the more astringency it will give either in decoction, infusion, or in any other mode it may be used for tanning; and I know, by experience, that the stronger the astringent, the sooner the coriagation takes place.

In the next place, how agriculture may be benefited by new plantations being properly managed.

By following my profession, a sailor, and living at and in the vicinity of St. Petersburg some time to learn the Russian language, (which I only mention as an introduction to my opinions on plantations,) I have had an opportunity of making my remarks both in Russia, Sweden, and Norway, on the natural woods. I mean such as have never been cultivated, but have decayed, and resown themselves since the creation, and from that state of nature I have drawn my observations and opinion.

I never yet saw where trees stood when young, or sprung up singly, that they ever grew straight, or to any size; but where the seeds had vegetated close to each other they always grew quick, straight, and tall; I mean trees in general not of one species; and the best trees are always thin, which are left after the others are taken out yearly to thin the woods, and for various uses, which is the custom in these countries; therefore I conclude, that when a plantation is to be made, it should be planted thick; but how far my observations on nature may agree with practice I cannot pretend to say, only that I never saw so fine wood as where it had sown itself thick, and had been properly thinned. If my observations are founded in error, I shall esteem it a favour if you have the goodness to tell me; and when the plants have grown to such a size as to interfere and rob each other, then draw them out annually, either to plant in hedge-rows for crooked timber, which will be wanted for knees and some other uses, the other small ones will do

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for hoops, &c. which agriculture or manufacture may want, with such small wood, and proceed progressively, as they will answer different uses every year, until the standards are left for timber; and I think thirty-three years will rear trees to a sufficient size for most purposes, if combined, some few excepted.

As crooked timber will be wanted for naval architecture, young trees may be bent, and will keep the curve given them; or the crooks that may be wanted may with facility be made with straight timber (which in my opinion will be preferable to natural ones) by the mode of combining. By the close mode of planting trees, they will carry their thickness higher up than if planted open, which in oak trees is a great saving, as in most cases where oak is used the form required is to have both ends of one dimension, or nearly so.

As I have not had any practice in agriculture or in plantations (only horticulture and nursery have been my amusement and for experiments), I cannot say with precision; but one thing strikes me very forcibly, that by drawing young trees from a close plantation it loosens the earth about the roots of the others, which admits fresh air; and manure may also be introduced, which will greatly promote the growth of the rest.

I have read the Bishop of Landaff's paper on timber with much pleasure, to find a person of his eminent abilities should prove, that it is the most advantageous time for the land owner to cut timber at the precise age agreeable to my plan, when they are fit for most uses.

I presume the Bishop of Landaff has made his calculations in general from timber growing near the Lake of Windermere, which cannot be so favourable to the growth of timber as many other parts of England. If I am informed right; by a gentleman from Norwich (whose name I do not know), who called on me a short time since out of curiosity to see my models, he said a friend of his, a Mr. Marsham, who had been dead about three weeks, had oak trees on his estate in Norfolk, of his own planting, which contained one or two load of timber each; such trees are large enough to combine for the largest mill-shaft in only four pieces.

I must now take notice of the price of timber in my calculation. I do not mean for landed gentlemen to sell their timber at half the price they now sell small trees, but to sell at half the price a beam or other large made piece now costs. I see the Bishop of Landaff and Mr. Marsham value small timber at about 1*s.* 6*d.* *per* foot, which may be about the price; but as small timber will answer the purpose of large by being combined, I then state it to cost government 2*s.* *per* foot, and 6*d.* more expense of combining, for which I can get any quantity done for; then call it 2*s.* 6*d.* *per* foot when wrought, (in small wood the waste is nothing compared to large); but wood for a beam, or other large piece, to be made as it is at present, will cost 5*s.* *per* foot unwrought (delivered to the yards), and there will be near one-third waste, besides as much iron as will pay for making one out of small woods. To elucidate the above, I have it in my power to give you the exact estimate (in the gross, I need not go into the minutiæ of it) of a 74 gun ship's main mast. I was sent down to Deptford to direct and superintend a model: there were two made there, one by my mode, and one by theirs; that made by their mode, the estimate was 611*l.* 10*s.* 6*d.*; that by mine was 227*l.*; so the saving is 394*l.* 10*s.* 6*d.* I allowed the same for making as them, which was too much, and the same for hoops, and charged my timber at 4*l.* 10*s.* *per* load, and they only 3*l.* 12*s.* *per* load, for their small timber. The difference arises by using large masts.

Scotland will or can supply all that may be wanted in that article. As I do not know any thing of politics, I cannot say whether it is best to have them from Russia, or there, but on the score of domestic economy Scotland certainly preponderates.

As agricultural improvement and a certain supply of timber is the subject of this paper, give me leave, Sir, to hazard an opinion, which I hope can offend no person, as my sole meaning is a general good, and it is only an opinion, though unasked. I do not remember any subject that has so often been brought up in Parliament, as a supply of timber for the use of the navy, and I never heard of any thing that has been done to ensure a supply. I think Parliament will never be able to effect it by premiums—if they were to go the extent by premium, of the expense of planting, that will not be worth the notice of the grower, and if they go further to insure the grower, that he shall not lose by his land, that will run away with a great sum from the nation; and if government were to give double the price, as the Bishop of Landaff states, which seems to me to be the best of any plan that has been proposed, then the landholder will just be paid, and the nation at double the expense.

But if government will adopt the mode of making large of small by combination, then every purpose is gained; the landed interest will gain eight times the present profit, and the nation be at half of the expense in large timbers.

I flatter myself that my calculations are within bounds; as I have supposed all large trees to be sound, which is not the case, and have not allowed any waste in large timber, when there is a great deal. If it should be brought into practice, half of the land now used for timber might be spared for other purposes.

On Marl, Chalk, and Clay.

By the Rev. JAMES WILLIS, *of Sopley, Ringwood, Hants.*

From the COMMUNICATIONS to the BOARD of AGRICULTURE.

AN opportunity has offered itself to my notice of reporting to the Honourable Board of Agriculture, the result of experiments made under my inspection, on marling, chalking, and claying, certain proportions of a farm, but of a much larger extent, and in a bolder manner than required by the Board. Perhaps the greater the breadth of the experiment, the greater will be proof of the effect of these manures, and may be esteemed not the less satisfactory to the curious agriculturist. The farm, which is the subject of this report, consists of 230 acres; the qualities of the strata, are a sandy loam, a small gravel intermixed with a dry clay, and the greater part of a clayey loam: it is situated in the parish of Christ Church, in the county of Southampton, rented by Mr. Thomas Whicher, who has occupied the same ever since the year 1776. This statement will point out to the Board, that Mr. W. was early acquainted with the powerful effects of marl, and chalk, as a manure on exhausted lands, and has had recourse to their aid and assistance for a period of thirty years, even to the present day. He entered the farm, with the hopes of recovering its lost fertility, by discreet and proper management, witnessing the renovating qualities of marl and chalk, though in a small way, in a neighbour's field, he was induced by this example, to follow up the same system of improvement on a larger scale, and the result has amply repaid him for his labours.

On Marling.

These lands border on that part of the New Forest, where there is a valuable marl pit, affording three sorts, all which have been analyzed, and found to be of the purest kinds; they equally effervesce; and there appears in their application, as a manure, no superiority of one kind over the other; they are used without any preference by the industrious farmer with uncommon success. The yellow marl is found four feet from the surface, the blue in the middle, and the shelly at the bottom. The last we should naturally suppose to be the best: but Mr. W. who has tried their effects altogether for so many years, tells me, he never has seen any difference in his crops, where the three sorts have been laid; and the only variation that he can discern, is, that the shelly works with the soil freer, and of course sooner than the other.

The marl is thrown from the pit with a small cutting spade in square pieces, and removed immediately in waggons to the field that is to receive it. Mr. W. always prepares his lands by a winter fallow. He regularly attends to this part of the process, knowing that this is the foundation of his future success, as marl carried on lands unprepared, is loss of time, as well as of money and labour. In the spring months, the land is ploughed and dressed three or four times; and when they are brought to their cleanest and finest state, in June and July, he brings from twelve to fifteen waggon loads per acre; it is then left to slake, which it does, like lime, with the sun and rain. If the season should not be favourable to its dissolution, he is put to an extra expense of beating it to the smallest pieces with mallets and hammers, which method is not only troublesome and costly, but not so effectually pulverizing it, as the influences of the atmosphere; subsequent harrowings are then employed, until it is completely incorporated with the soil. When the summer has smiled on his exertions, he has had time to manure his field with stable dung, by the middle of August, when he invariably sows turnips in the broad cast way, and has had usually the most abundant crops, which are fed off by sheep, by the following October; the ground is then ploughed up, and without any other preparation is sown with wheat, which always turns out to be equally abundant. But many summers vary the advantage of this double crop; his aim, however, is, if possible, to procure a turnip crop, preceding the wheat. The usual mode of manuring and cultivation are never omitted, as if he rested solely on the effects of marling; this is not to be expected, and whoever does, will surely be disappointed. Mr. W. who has lived many years to enjoy the fruits of his labours, has never marled any of his fields twice over. But this he has done more than once, on these lands, where he has carried chalk. The former, he considers, will remain with effect in his lands for forty years, the latter, at the most, for twenty. The clayey loam, and the gravelly clay, are the parts of his farm, which he has so very materially improved by marl, and the sandy loam with chalk. The natural weeds of our soil are charlock, and the corn marygold, provincially called boaden. This weed strikes deep in the mould, requires much nutriment, and is a deadly enemy to every sort of corn. Its intrusion in our crops, calls forth all the energy of the farmer for its extirpation; and the most effectual remedy for this purpose, I can venture to prescribe, are the dressings of marl. Under its influence, charlock gradually disappears, and the corn marygold is radically destroyed.

Fallowings, repeated hoeings, with a turnip crop, will do much in the removal of these annoying weeds; but if we rely on a pure and spirited system of husbandry for pleasure as well as for profit, we must have recourse to the marl and chalk pit. Mr. W. has opened the eyes of his neighbours on this point by his exertions most effectually, and they know, and see, in spite of their former prejudices, that his acres are improved from 10*s.* value to that of 30*s.* It certainly was an adventurous undertaking to cover such a breadth of soil, as 230 acres, with such expensive manures; the carriage alone was sufficient to check the ardour of the most sanguine agriculturalist; but he felt his way, which convinced him of its utility, and nothing deterred him from completing his object in view.

In his younger days, as I before observed, he saw the surprising effects of a small quantity in his neighbour's field: as his own were contiguous to the pit, and of the same quality, he reasonably concluded that the same cause would produce the same effects; he manfully commenced his operations, which have been crowned with the most complete success.

His last experiment with marl was made on a field of sixteen acres; part of the same was a clayey loam, the other gravelly clay. This field he took into his hands in the year 1804. His predecessor quitted the land in the worst state of husbandry, eat up with weeds, and promising no return: the first step was to plough the field for a winter's fallow: he ploughed it three times, in April, May, and June, dressed it with the drag and harrows, brought fifteen loads of marl from the pit: the summer speedily dissolved the pieces; in the beginning of August, he carted twelve loads of stable manure on every acre; the marl and manure were ploughed in together; one pound of the green round turnip was dressed in *per* acre; they were hoed twice at 6*s.* *per* acre, and the weight of the crop twelve tons. Three hundred and fifty sheep eat off the crop, time enough in September, to sow the field with red-necked wheat, which yielded seven sacks *per* acre, at nineteen pounds *per* load.

We cannot discover a readier and more effectual method of restoring exhausted farms, than the above statement. Where marl can be procured within a certain distance, this, in conjunction with farm-yard manure, horse or cow, will give the cultivator the most promising hopes of the most permanent improvement. This marl, fortunately for those who set a true estimate on its value, is of the real genuine quality; it works with the soil most intimately even the first year, and assists the principles of vegetation more expeditiously, than any I have ever seen. On reflection, we are astonished that so little of it has been used as a manure heretofore. Mr. W.'s judgment and example has completely obviated the doubts of the bigotted and prejudiced in respect to its fertilizing qualities, and has contributed more than any other person in this part of the world, to the introduction of this highly valuable manure. He finds by his calculation, which I have seen, and is accurately kept, that he cannot bring to any part of his farm a load of marl, the wear and tear of waggon and horses, expense of digging, and other incidental charges included, for less than ten shillings. The men employed will throw four loads a day; they charge the farmer one shilling *per* load. As the work is very laborious, and they are perpetually in the wet, four shillings *per* day must not be considered as too much. The cost to others, of course, must be proportioned according to the distance from the pit.

I feel much pleasure in reporting to the Board, as a certain indication of the general benefit, resulting from the practice of marling, that fifty waggon loads are now taken from this pit where only one was twenty years ago, excepting what was carried by Mr. W. long before that time, when he first discovered the nature and value of this manure. I must not omit an experiment tried by Mr. W. in 1801. He marled an eight-acred field after the usual preparations of fallowing, ploughing, and dressing; put twelve loads of marl *per* acre, and thirteen loads of stable manure on every acre; but the middle acre, at harvest, was inferior to the best of the field in its product by five bushels of wheat; it was extremely full of red weed, but neither charlock nor corn marygold appeared at all. This difference in the crop of the middle acre must be ascribed to the want of the stable manure, which was purposely omitted in its cultivation, to prove that marl alone, without the assistance of compost, and farm-yard manure, will lose at least one half of its power and effects. Mr. W. never laid marl on grass lands but once, in 1805. The field was rye-grass and broad clover; it was fed early, so as to enable him to bring the marl on in the first week of June; when the marl was pulverized; the field was raftered twice, fifteen loads of farm-yard manure carted on every acre, ploughed and sowed with red-necked wheat the fourth of October. The soil was the loamy part of the farm, and considered the best land, weeded in the spring, and in all respects promising a good crop; but at harvest the produce was small indeed, scarce four sacks *per* acre.

TO BE CONCLUDED IN OUR NEXT.

Description of a new air-tight Door Hinge.

By Mr. MARTIN FURNISS, *No.* 128, *Strand.*

With Engravings.

Ten Guineas were voted to Mr. FURNISS *for this Invention.*

From the TRANSACTIONS of the SOCIETY for the Encouragement of ARTS, MANUFACTURES, and COMMERCE.

Fig. 9, (Plate XIII,) a plan of the joint: AB, two sides of the screens with circular ends, joined by a piece of leather reaching from top to bottom fastened at C, and wrapping (like the letter s) partly round the curve of one fold of the screen, and partly round the other to D, where it is also fastened: EF, a chain formed of brass plates rivetted together, winding round in a groove from off one fold of the screen on to the other, the contrary way to the leather, and thus mutually keeping each other stretched tight, the chain winding on when the leather winds off, and *vice versâ;* thus they move smoothly round one another. G Fig. 10, a piece of brass (left out in the last figure in order to shew the chain) screwed to the centre of each curve of the screens which forms the hinge, and by keeping the folds of the screen at their proper distance secures the easy action of the chains and leather, and prevents their being over-stretched. H H, a line of green twist fastened along the bottom of the screens, and passing through a staple on the joint at G, serving to keep the screen air-tight on the floor.

Fig. 11 is an elevation shewing the top and bottom joints, with the same letters of reference.

A Certificate from Messrs. Wilsons, cabinet-makers in the Strand, testified that Mr. M. Furniss's model for screens or doors, is his own entire invention, and has been executed by them on a high-folding screen for a lady in Baker-street, Portman-square.

Description of a Compensation-Pendulum for a Clock or Time-piece.

By Mr. HENRY WARD, *of Blandford in Dorsetshire.*

With Engravings.

From the TRANSACTIONS of the SOCIETY for the Encouragement of ARTS, MANUFACTURES, and COMMERCE.

Fig. 7, *h h i i*, (see Plate XIII.) are two flat rods of iron or steel, about half an inch wide, and an eighth of an inch thick. *k k* is a rod of zinc interposed between them, and is nearly a quarter of an inch thick. The corners of the iron rods are bevelled off, that they may meet with less resistance from the air; and it likewise gives them a much lighter appearance. These three rods are kept together by means of three or four screws *llll*, which pass through oblong holes in the bars *hhkk*, and screw into the rod *ii*. The rod *hh* is connected to the one *kk* by the screw *m*, which I call the adjusting screw. This screw turns in the rod *hk*, passes through the zinc rod *kk*, and screws into the iron rod *ii*. The rod *ii* has a shoulder at its upper end turned at right angles, and bears on the top of the zinc rod *kk*, and is supported by it. It is necessary to have several holes for the screw *m*, in order to adjust the compensation. See Fig. 8.

Now it is evident, that if any degree of heat or cold be applied to this compound rod, the one of zinc expands and contracts as much as the two iron ones together; the distance from the point of suspension to the centre of oscillation must remain the same.

In proportioning the length of the rods, I made use of Mr. Smeaton's table of expansion of metals, in the 48th volume of the Philosophical Transactions: where he shews, by experiments made with a pyrometer, that the expansion of iron is to that of unhammered zinc, with the same degree of heat as 151 to 353, and to that of zinc hammered, half an inch per foot, as 151 to 373. This great expanding property of zinc renders it in theory extremely fit for the purpose of compensation in a pendulum; and I was desirous of knowing if it would answer in practice, and likewise the exact proportion that was requisite to answer the intended purpose.

I made two regulators whose pendulums were composed of iron and zinc, as above described, with this difference, however, that one had a detached scapement of a particular construction; the zinc rod was not hammered, the ball of a lenticular form, and weighed twenty pounds, its arc of vibration nearly five degrees. The other had a simple remontoiring scapement, the zinc rod was hammered half an inch per foot, the ball, of a spherical form, weighed forty-six pounds, and vibrated two degrees and three quarters.

These regulators were both placed in the same room, and their cases firmly fixed to the wall; the pendulums were suspended from a stout brass cock, screwed to the back of their respective cases. In the inside of each case, and immediately behind the pendulum rod, was hung a thermometer, for the purpose of comparing the degrees of heat. I adjusted them to mean time nearly by corresponding altitudes of the sun. After having compared them together for several days, I found that the one which had the hammered zinc rod went somewhat faster when the air of the room was heated by a fire in the grate than the other did. Hence I concluded that the difference of expansion of hammered and unhammered zinc was greater than Mr. Smeaton made it, at least it appeared so in this instance.

But to determine whether the length of the hammered zinc rod was accurately proportioned to that of the iron ones, I wished next to prove, without waiting that length of time that nature would require to produce a sufficient alteration in the temperature of the air, I proceeded to make the following experiment: I caused to be made a tin tube six feet long, and two inches and a half diameter at its larger end, from whence it gradually tapered to the other, which was only half an inch diameter. Within the case, and as far from the pendulum as possible, I placed this tube; the smaller end was carried

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carried through a hole in the top of the case, and projected a few inches above it. In the lower end of the tube was inserted the nozzle of a lamp, and immediately under it, in the bottom of the case, was a hole of an inch diameter to supply the lamp with air. By this means the tube would communicate as much heat to the internal air, as to raise the thermometer about thirty-five degrees.

Previous to the lamp being put in the case, I made both pendulums vibrate exactly together, and after an interval of twenty-four hours, the one with the hammered zinc rod had gained, as near as I could judge, one tenth of a second. The mean height of the thermometer was fifty-three degrees. I now lighted the lamp, and in about four hours every part appeared to be thoroughly heated, and the thermometer arrived at its maximum, which was eighty-eight degrees; at this point it continued with little variation. While the heat was increasing I found the motion of the pendulum was accelerated. I again made them beat exactly together, and in about ten hours after, the heated pendulum had gained one second; the thermometer in the other case continuing nearly the same. The lamp was then taken out, and as soon as the parts were cooled, and both thermometers shewed the same degree, I adjusted the beat of the pendulums as before, and, at the end of twenty-four hours, I found the pendulum that had been heated kept precisely the same rate as it did before the experiment was made.

By this experiment the zinc rod was evidently too long, and that by a considerable quantity. The pendulum was then taken down, to have more holes made for the adjusting screw; and after many repeated trials with the lamp and tube, as before, I found the length of the zinc rod to be 22 inches, and consequently the length of the iron ones together 39,2 × 22 = 61,2 inches, or, the expansion and contraction of iron to that of zinc hammered, half an inch per foot, as 151 to 420.

Having thus far satisfied myself with the hammered zinc rod, I proceeded to make similar trials with the one that was unhammered; in doing which a circumstance occurred that I cannot account for, that when the air in the case was rarified by means of the lamp and tube, the arc of vibration would be about half a degree less than it was before the lamp was applied, which is directly contrary to what I should expect would have taken place. I afterwards found that the other pendulum was affected the same way, but in an extreme small degree, which, without doubt, was in consequence of the ball being much heavier, and vibrating a smaller arc. In taking the rate of the clock when the lamp was in the case, I at first computed from theory the error that would arise by such a diminution of the arc, and allowed for it accordingly; but doubting whether the unlocking of the swing wheel might not form a decrease of velocity in the pendulum, and have a great tendency to retard its motion, I therefore thought the experiment would be rendered more accurate if the maintaining power was increased until the arc of vibration should be the same. After several trials I found the length of the unhammered zinc rod to be about twenty-nine inches, which agrees pretty nearly with Mr. Smeaton's experiments; that is, in regard to the relative expansion of iron and unhammered zinc.

The zinc rod of the pendulum, which I here send to the Society of Arts, was hammered three quarters of an inch per foot; and by making experiments with it as I had done with the other two, I found the length of it to be twenty-two inches, which is exactly the same length as the one that was hammered half an inch per foot, so that it seems nothing is gained after hammering it to a certain degree; but I cannot think that any rule can be laid down to enable us to judge of the degree of expansion that will take place with a determinate increase of heat, from the quantity that is extended by the hammer; much depends on the degree of curvature and polish of the stake and hammer, and probably on the heating of the rod at the time; for it is necessary to heat it a little hotter than boiling water, otherwise it will crack in hammering.

In all these experiments it is to be understood that the ball of the pendulum was suspended by its centre; but if the ball be made to rest on its lower edge, the expansion and contraction of it must be taken into consideration.

It has been the opinion of some mechanists that zinc is an unfit substance for a compensation-pendulum, because they have thought it too soft for the purpose, and that after being heated or cooled to a considerable degree, it does not return to its original dimensions. If that was really the case, no doubt but it would be a general one common to all metals in a greater or less degree; but from the experiments and observations I have made on zinc pendulums, I am fully satisfied there is no foundation whatever for such an opinion. Some time in the latter part of last summer, I however noticed a circumstance that made me doubt the matter—for when I first used any zinc pendulum, I never could bring the clock to keep the same rate two days together, but that it was continually retarded, whether I used the lamp or not; and had I not before observed a similar effect on a lever pendulum that was made of brass and steel, I should have ascribed the cause wholly to the softness of the zinc rod; but by constantly comparing its daily rate with one that had been going a longer time, I found this retarding property gradually wore off, and in less than a month would become quite settled to the rate that it would afterwards keep. By subsequent experiments with the lamp too, I have constantly found that all the pendulums I have hitherto tried kept precisely the same rate, both during the time they were heated (provided they were properly adjusted) and afterwards, as they had done before. The cause of this retardation appears to me to be, that the points of contact of the different pieces, which compose the pendulum, are more closely connected after a little time than they are at first, that is, those points of contact do, by the weight of the ball, yield to each other in a smaller degree, until they get a broader bearing.

The advantages of this pendulum are, 1st, that from its simplicity it will never fail to have the desired effect. 2ndly, That no extraordinary care is requisite in executing it. 3dly, That the compensation may be increased or diminished with the greatest ease, without stopping the clock more than a minute, by making fast one of the screws that keep the rods together whilst the adjusting screw is removing, taking care to release it again afterwards; and, 4thly, That it can be manufactured for less expense than any other compensation-pendulum hitherto published.

N. B. The compensation of this pendulum which I now send to the Society of Arts is properly adjusted, at least

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least very near the truth. The holes for the adjusting screw are made at such a distance from each other, that by removing the screw one hole, it will produce an alteration in the going of the clock of about a quarter of a second per day with a change of thirty degrees of Farenheit's thermometer.

I shall state the observations I have made since my compensation-pendulum was laid before the Society.

The regulator, with the hammered zinc rod, and ball of forty six pounds weight, was firmly fixed to a brick wall at the top of my house. The adjustment of the length of the rods, by means of a lamp, was repeated as before. There was, however, an alteration necessary to be noticed; the ball of the pendulum rested on its lower extremity, instead of being suspended by its centre. I prefer this method, as being less liable to error if the rods should be affected by heat or cold, quicker than the ball. The length of the zinc rod, as ascertained by the lamp, was now found to be 20¼ inches.

The clock was then set to mean time, and suffered to go without alteration; the result is exhibited in the following table.

1806.	Error of Clock at Time of Observation.	Number of Days between the Observation.	Daily Rate.
March 21	0″ 0	18	× 0″, 15
April 8	× 2, 8	32	— 0, 18
May 10	— 8, 7	16	— 0, 80
—— 26	— 21, 5	26	— 1, 10
June 21	— 50, 0		

Increased the compensation for heat and cold, 6 holes =4¾ inches, or, the length of the zinc rod 25 inches. The clock was again set to mean time.

July	1	0″ 0	26	—0″ 36
——	27	— 9, 3	13	—0, 21
Aug.	9	—12, 0	7	—0, 31
——	16	—14, 2	28	—0, 34
Sept.	13	—24, 0	12	—0, 80
——	25	—35, 5	22	—0, 84
Oct.	17	—52, 1		

Although a thermometer was attached to the clock, I could not from a necessary attendance to business register it regularly; the difference of its height in March and June may be taken at about 22 degrees, and in July and October 14, without much error.

On comparing it with the rate of the clock, the compensation, in the latter case, appears nearly as much too great, as it was in the first too small. The true length of the zinc rod ought to be about 23 inches.

The length of the zinc rod, thus ascertained, is 1¾ inch more than the experiment by the lamp makes it; indeed, I have always suspected there might be some error in that experiment, on account of the length of the arc of vibration being affected by it.

Having no means of finding the time accurately but by equal altitudes, I could not get so many observations as might be wished. I trust, however, that these will not be found altogether useless.

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Fig. 1.

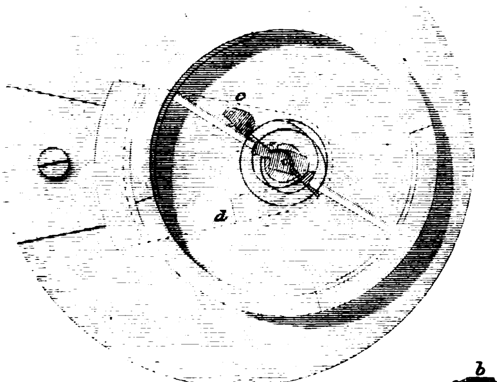


Fig. 7.

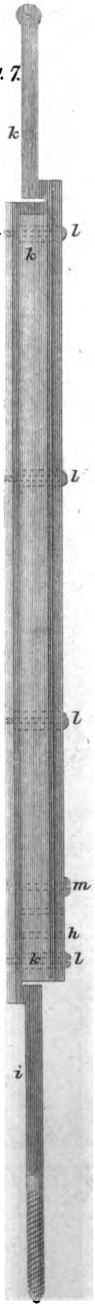


Fig. 8.

Fig. 2.

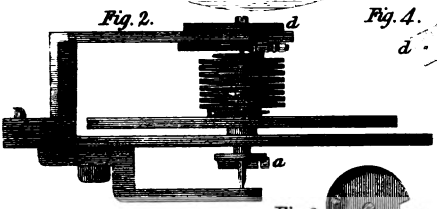


Fig. 4.

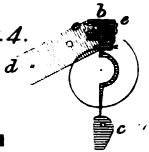


Fig. 3.

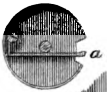


Fig. 5.

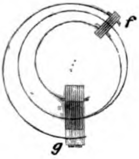


Fig. 6.

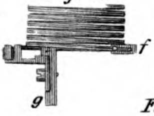


Fig. 9.

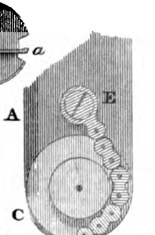


Fig. 11.

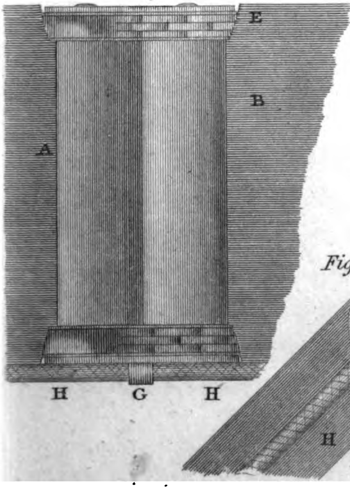
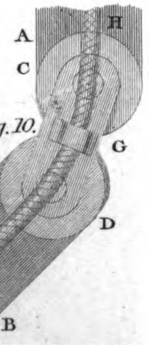


Fig. 10.



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Methods of equalizing the long and short Arcs of Vibration in Time-keepers.

By Mr. WILLIAM HARDY, *of St. John-street, Clerkenwell.*

From the TRANSACTIONS of the SOCIETY for the Encouragement of ARTS, MANUFACTURES, and COMMERCE.

The Silver Medal was voted to Mr. HARDY *for this Communication.*

With an Engraving.

THE equalization of the time of the different arcs of vibrations of the balance of a time-keeper, having lately given to rise much discussion, I beg leave to offer for the approbation of the Society, three different modes of obtaining this end. The first method is by a straight spring placed edge-ways across the diameter of the impellent pallet *a*, Fig. 2 and 3 (Plate XIII), and screwed at the end opposite to the direction of the wheel, on its approach towards the centre of this pallet; at the other extremity of this spring is a flat face, or curved surface, to receive the approaching tooth of the escape-wheel, which gives the impulse; this spring acts between two pins placed in the pallet near its end. By reducing this spring to a certain degree of strength, so that it may yield a little to the force of the wheel in giving the impulse, the different vibrations will be performed in the same time; but the proper degree of strength can only be determined by repeated trials. This method possesses, besides, this farther advantage, that the acting surfaces are not so liable to be injured by the drop of the wheel upon the spring, as upon a solid surface, nor the vibrations of the balance so much disturbed by the impulse,

impulse. The second method is by a straight spring *b c*, Fig. 1 and 4, screwed to the under part of the cock, placed edgeways and diametrically over the cylindrical spring, and having a piece cut out to clear the arbor of the balance. This straight spring is at one extremity fastened to the end of the pendulum-spring, and, at the other extremity, its elasticity is reduced so as to yield a little before the pendulum-spring operates; on the opposite of the cock, where the spring is screwed, is fixed a stud *d* projecting downward, and having a slit to admit the small piece at the end of the spring *b*; on each side of this slit is an adjusting screw *e e*, whose points face each other, and are placed so as that the spring may move equally between them from its point of rest. The action of the spring between the adjusting screws, requires to be somewhat less than the angle of escapement. Let the balance be made to vibrate, so that the straight spring may move up to the adjusting screws upon each side, and no farther, being weaker than the pendulum-spring, its exertion will be less; hence the time of the vibrations will be prolonged, but as they increase, the exertion of the pendulum-spring will commence and progressively accelerate them, and this acceleration will always be in proportion as the exertion of the pendulum-spring is to the action of the straight spring between the two adjusting screws. Thus it will always counteract the accelerating effect of the escape-wheel in the small arcs of vibration, so that the whole of them shall be performed in the same time. The third method is by connecting a piece of short spring-wire to the pendulum-spring, by a small piece *f*, Fig. 5 and 6, with two holes, and pinning the two springs together about half a turn from the stud of the pendulum-spring, and clamping the other end of the short spring at its natural point of rest to a sliding piece, *g*, which projects out from the pendulum-spring stud. By this manner of fastening, both springs will act together, and each will retain their natural point of rest; but by moving the sliding piece, which clamps the end of the short spring, and placing the spring a little on the strain, in opposition to each other's exertion, the point of rest of both springs will be destroyed. Thus by producing this counteracting force in the two springs at the lowest point of vibration, the accelerating effect of the escape-wheel upon the balance in the small arcs of vibrations will be corrected, thereby the whole of them will vibrate in equal time.

Extract from Captain William Brown's Letter, addressed to Mr. John Nichols, Millpond-bridge, Bermondsey.

Respecting the chronometer which I purchased from Mr. William Hardy last year, the jolting of the coach in the conveyance to Liverpool, altered its rate of going to 34″ slow, which rate it continued so exactly, that in making Cape De Verd, on the coast of Africa (the longitude of which has been correctly ascertained), in 24 days from Liverpool, and carefully measuring my distance to the Cape, I could not discover it to have deviated from that rate, say 34″ slow, not one second in the whole time; and I have every reason to believe, that it continued the same rate until my misfortune, when it got immerged in sea water, having lost my ship on a shoal five or six leagues from the Riopongas, this dangerous bank not being laid down correctly, nor the latitude nor longitude given in order to avoid it.

A Treatise on the Diseases of Sheep; drawn up from original Communications presented to the Highland Society of Scotland.

By ANDREW DUNCAN, *Jun. M.D. F.R.S.E. and A.L.S.L.*

(Continued from page 286.)

ACCIDENTS from drifting snow.—"These are most fatal when the frost is keen, the wind violent, and the snow light and mobile. The defenceless flocks move before the blast, into some hollow place, where they find some relief from the piercing storm. There, in a short time, they are covered up deep with snow drift; and if long confined under it many of them die, the survivors being much reduced, and sometimes having lost part of their wool. Should this retreat be a rivulet course, as often happens, and a sudden thaw come on, the melted snow brings down a torrent of water on them, and they all perish. Smooth, green hills, destitute of rocks, woods, or other shelter, are most in danger from snow drift. Of this description are most of the sheep farms in the parish of Eskdale-muir; and on the fatal storm on the 24th of January 1794, above four thousand sheep and some heifers were lost in that single parish. I have been told that Mr. Robert Hope, at Newtown, in Crawford-muir, sold 50*l.* worth of skins that year, at 8*d.* each. Many store-masters lost ten, twenty, thirty, or forty score of sheep; and many shepherds also lost their lives in quest of their flocks. An amazing fall in the barometer gave warning of that particular storm. Tradition records, that the year 1674 was fatal to most of the sheep in the head of Eskdale, by snow drift, in the end of February and beginning of March. A long course of frost and snow was destructive in 1740: the year 1745 was of a similar description: the seasons were successively calamitous from 1751 to 1755: one third part of the stock were lost by frost and snow in 1772. Then, after some favourable intervening seasons, followed the fatal storm in 1794. These facts have been accurately collected and recorded by the minister of Eskdale-muir, among many others of importance to his parish, partly in manuscript, and partly in his statistical account thereof; and his accuracy and integrity are well known.

"To preserve the sheep during snow drift, they must be collected in the best manner, and safest way that can be done, and kept moving, to prevent two evils; one is, their being benumbed with cold, and the other is, their being overblown with drift. Many sheep have perished benumbed with the piercing storm, and have been found on their backs, with their feet straight upwards. Stone bields are of use, no doubt; but the true and effectual shelters are plantations of forest trees, to which the sheep make, of their own accord, when warned by Nature of the approaching storm." Mr. Singers.

Accidents from falling wreaths of snow.—"When the blasts of winter have accumulated vast masses of driving snow, in a spiral form, near the top of some rising ground, or projecting rock, and the sheep have taken their station farther down, where they find a temporary shelter, the weight of the mass increasing above them, it is at last precipitated down on the sheep, and they are miserably crushed, buried up, and lost. Such a shelter is always beheld by the attentive shepherd with a jealous eye. But in large farms, destitute of all shelter, natural and artificial, how can he relieve them? They cannot continue without food, to walk incessantly among the snow; and if they lie down to rest themselves without shelter the cold is so intense as to freeze them to death; or if the shelter they find is of the dangerous kinds mentioned, they are drifted up out of sight, or crushed with falling masses of snow.

"Thirteen sheep belonging to Mr. Gibson, at Polmood, in Moffat Water, were overwhelmed at once, and hurried down to a great distance, and most of them killed. This instance is only one out of many. The mass of snow that carried these down, was of such dimensions as to have covered as many scores, if they had happened to be there, in its way." Mr. Singers.

Accidents from mock thaws.—"When a partial thaw comes on after a fall of snow, and is followed by hard frost, the sheep are all at once deprived entirely of their food. They could have dug into the snow while it was soft, and found subsistence at the bottom of it; but this cannot be done when half thawed, and afterwards crusted over by a frozen plate. If such a state of things continue above a day or two, the sheep must be supported in another manner, otherwise they fall greatly away, and become very unfit to contend with the severities of the remaining parts of winter and spring. To retreat into a lower district, where they may find pasture, is not always practicable. Of what importance, therefore, does a stack of good hay appear when the stock is in such a situation. A stone of good hay supports a score of sheep for a day, computing 24lbs. averdupois to the stone; and they lose very little of their vigour or flesh.

"Proprietors may consider the importance of such a provision: and if they desire to see the stack of hay, it is necessary to give encouragement to rear it, and to furnish a stimulus by their countenance and attention.

"I have known farmers paying snow mail, at the rate of 10*l.* *per* day; and their sheep after all poorly subsisted." Mr. Singers.

Accidents by birds and beasts of prey.—"The wolf has been destroyed out of Scotland, in which it certainly once haunted: but the destruction of the fox must be conducted with more zeal and keenness, before this artful and formidable enemy of the sheep can be banished, like his elder brother the wolf. The wild cat, *ferus*, possesses extraordinary fierceness and strength, and is destructive to the lambs and poultry from its haunts in the woods. The foumart, a species of the *mustela*, is also cruelly mischievous among weak lambs, unprotected. Eagles chiefly frequent the northern districts, and their strength and depredations are well known; but the ravens are probably more destructive, being ready to attack the sheep in all cases of distress, and exceedingly quick-sighted in discovering these.

"It is the real interest of proprietors and farmers in every quarter, to give premiums, to such as will accept them, for the claws and skins of these birds and beasts; to support and assist fox-hunters; and to persevere, without intermission in their efforts, so long as an individual of these carnivorous animals is known to frequent their lands. Excellent regulations have been introduced on this subject, in particular districts and estates; but very commonly the alacrity subsides, and people relapse into indifference. Of course, these noxious animals multiply, and renew their depredations. I have heard of farms so infested by them as not to command their real value in rent, by one-third part, in consequence of the mischiefs apprehended." Mr. Singers.

Rot, or poke.—The effect of the modern improvements in sheep-farming, in lessening the frequency of this insidious and destructive disease, has been so great, that I feel myself almost warranted in adopting the figurative exordium of Mr. James Hog. "I shall now endeavour to describe that other ravager, the rot, whose appearance, haunts, and lineage, I shall so minutely scrutinize, that he shall without fail be apprehended and banished the country, or forced to fly into a voluntary exile."

As sheep, however slightly tainted with the rot, never recover perfectly, and as in the early stages of this disease they fatten as quickly as healthy sheep, it is of great importance to the store-master to be able to distinguish them as soon as they are affected, especially when drawing his stock about Martinmas. The following rules are given by Mr. Beattie.

"The first thing to be observed is in the Spring, when they are dropping their lambs. A sound ewe, in good order, drops a lamb, covered with a thick and yellow slime, which the ewe licks off it, and the rule is, the sounder and the higher condition the ewe is in, the darker and thicker will be the slime; but when they observe a ewe drop a lamb covered with thin watery bubbles, and very white, they note her down as unsound."

"About the month of September, when they intend to dispose of their draught ewes, they put all their sheep into a fold, and draw them by the hand, that is, they catch them all, *viz.* the ewes they design to sell any of, and clapping their hand upon the small of the back, they rub the flesh backwards and forwards, betwixt their fingers and thumb, and the ends of the short ribs: if the flesh is solid and firm, they consider her as sound; if they find it soft and flabby, and if, when they rub it against the short ribs, it ripples, as we term it, that is, a sort of crackling is perceived, as if there was water or blubber in it, they are certain she is unsound. This is the most certain of all symptoms, but is not to be discerned, with any degree of certainty, but by an experienced hand; for although, as I have here related it, it seems a very simple affair, and easily acquired, yet it is well known, that many shepherds who have followed sheep all their lives, never arrive at any thing like certainty, in judging by the hand, whilst men of superior skill will seldom be mistaken, and will draw by no other rule. Yet still it must be acknowledged, that the seeds of this disease will sometimes lie so occult, as to baffle all skill, and that no man can, with absolute certainty, draw a stock tainted with the rot. There is another method to which men of inferior skill resort, which is more easily acquired. They take the sheep's head between their hands, and press down the eyelids, they thereby make the sheep turn its eyeball, so that they get a view of the vessels in which the eyeball rolls; if these are thin, red, and free of matter, they consider the sheep as sound, but if they are thick, of a dead white colour, and seem as if there was some white matter in them, they are confident she is rotten: this is a pretty general rule, and easily discerned; but I think, it is not so certain as when they are judged by the back; for in firm heathy lands, the eye of a sheep is far redder, than it is in sheep upon grassy lands. And in some boggy lands, the eye is never very red, be the sheep ever so sound: so that there you cannot so well judge by the eye; but when you see the eye of a sheep a good deal whiter and thicker, and more matter in it (I mean the vessels in which the eyeball rolls), than the run of the flock amongst which it feeds, you have reason to suspect it is not sound.

" There is another method by which I have seen some men attempt to judge of the soundness of sheep. It is a well-known fact, that when sheep are rotten, the lungs swell to a greater size; they, therefore, lay the sheep down upon its broad side, and pressing the skin in at the flank, up below the ribs, pretend to feel the lungs. But if there is any thing to be learned by this, I could never perceive it, and have seen some men, who pretended to know most by it, very often mistaken.

" These are the principal rules by which the Highland farmers draw their stocks; and they relate all to ewe stocks; for as to wedders, they are generally all sold off when they are three years old; and those that buy them for feeding, mostly buy them by the condition they appear outwardly to be in at the time, and the character of the ground upon which they were bred."

In addition to these marks, Mr. Scott thinks the distribution of the fat in the different parts of the body affords good grounds for judging of the soundness or unsoundness of sheep. If the back be poor, there is danger; but if, at the same time, the breast and belly be fat, the danger is much greater; while, on the contrary, if the under parts be lean, while the back is tolerably fat, the animal is sound.

The appearance of the mouth, and state of the teeth must also be examined. If the tongue be red and clean, it is a good sign, but if the gums look pale, and the teeth are wide and narrow at the top, she should be kept no longer, as she is unable to eat the fine ley grass, which grows

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grows upon what is called hittle ground, but is obliged to take the tath, and is apt to be infected. "The age of a sheep," says Mr. J. Hog, "is easily known from its teeth. In its second year it has two broad teeth in the middle; in its third year, four; and when rising its fourth year, six broad teeth. Next year its teeth are all cast, and consequently all those called broad teeth; and when it is five years old, and rising six, they grow as narrow at the top as at the root, whereas before, each tooth spread at the top. If the sheep is not a very good one, it should be put off this year, especially if on a soft ground, and of the Cheviot breed. An ewe on a hardy ground will hold out a year longer, and the next year, when outgone six, the teeth are narrower at the top than at the root, and then they should be kept no longer; for as they open at the top, the grass on pulling gets between them, which incommodes them so much that they cannot thrive. When they grow old, their foreteeth also appear each with a point below, the gums having fallen down from the middle of them, where there appears some yellowish stuff, resembling putty."

If an unsound ewe be left among the flock at Martinmas, she may live, if the winter be uncommonly mild and good, but will never turn to any account; but if the winter should prove severe, or if she experience any want of food, she acquires a languid sleepy look, the eyes become heavy and inanimate, she is listless and inactive, and her voice becomes feeble. On removing the flock from one place to another, she always falls in the rear, and will not give herself the trouble of searching for sound food, but inclines to go by herself, and always eats in the heads of springs or marshy places, where a kind of tender grass rises early in the season.

Even

Even at night, when sound sheep go to the tops of the hills, she loiters behind, and lies about the burnsides and flats at the bottom. When obliged to run or ascend a hill, she wheezes and coughs, and seems quite exhausted. At last she will not go up a hill at all; but if you attempt to dog her up she directly turns and runs down; and if you attempt to drive her without a dog, however gently, she will lie down before she reaches the top. Even in this stage an ordinary observer will not discover that she is at all ill, when she is allowed to stand or go at ease; for in general she appears bulky, and does not seem to have lost much flesh.

Her shape now begins to change, the belly being shrunk and drawn upwards for some time, and so long as this is the case she eats voraciously; but as the disease advances, the belly falls down, and the flanks sink in. The wool, although, according to Mr. Scott, its pile becomes finer, assumes a dry withered appearance, seems thin and ill coloured, and it continues erect, but it is loosely attached, and comes easily away in handfuls. Her neck seems to lengthen, and she is unable to raise its head. A bag or swelling, filled with bloody serum, often appears beneath its skin, in mild, damp, or rainy weather, decreasing for a time, when it becomes frosty or dry. The tops of her ears hang down on a level with the roots; she slavers much, and the eyes are large and heavy, with a white spot above the star. A kind of scab sometimes appears over the body, said to be infectious. She becomes quite lean, her debility increases, the swelling beneath the chin sometimes reaches an incredible size, very great thirst takes place, and the purging of a blackish matter is the harbinger of death.

Appearances on dissection.—If opened soon after it is dead, a sheep which dies of the rot emits very little smell. Upon taking off the skin, which is unusually tender, the fell, as it is called, is entirely white; and the whole carcase has a dull white, or leaden colour. In the belly water is sometimes found. The liver, and especially its concave side, is always enlarged, sometimes to a very extraordinary size, and instead of its healthy red colour, is of a livid dun, variegated with many white spots. These correspond with indurated portions of its substance, which are the more easily felt, as the other parts are soft and spongy; or it appears as if interlarded with layers of sand. Both upon the outside of the liver, and in its ducts, are generally found great numbers of an ugly flat insect, having some resemblance in their shape to flounders or flukes *(faciolæ hepaticæ)*. These are not, however, peculiar to this disease, as they are found, though very few, and very small, in most aged sheep, and as in some rotten sheep they do not exist. When the liver is very rotten, it is also studded with hydatids or globules of water, which are likewise found adhering to the lungs, and among the tallow. Besides, the liver does not stiffen when boiled, and is said by Mr. W. Hog to become very quickly putrid. The small intestines are blackish and tender, as if they were rotten, and will scarcely bear handling, and the lacteal glands, or clyars as they are called, are always swelled and hard.

The lungs are likewise swelled to a great size, and assume a whiter colour, and are often streaked on the outside with white, and under these streaks are to be found hard substances, like cartilage, or even bones.

Mr. Stevenson is more particular in his description.

"In the rot the lungs are the principal seat of the affection, and on opening the body they are found sometimes almost destroyed. In the whole of their cellular substance there are a number of white round knobs, of a larger or lesser size, which in the parts most affected are found swelled into a bag, which is filled with white and pure matter. Some of them are very large, and the side of the lungs in which they exist is quite destroyed, and a membranous bag left in their place, full of matter, of a thinnish appearance, which is at times coughed up. Hence arises the difficulty of breathing.

"When these swelled parts, or tubercles as they have been called, are in the lungs, the latter generally adhere to the side of the ribs, which they do not do in a natural state. These tubercles I have seen in lambs, scattered through the substance of the lungs, like so many pin heads. In general, the left side of the lungs, or that in which the heart lies, is most affected in rot. The lungs are found at times considerably swelled, and a collection of water around them. This is only, however, towards the beginning of the disease."

The mutton of rotten sheep does not stiffen when cold, but remains flaccid, and when boiled dissolves away to mere membrane, and has a weak, watery, and insipid taste; the muscular fibres are pale and wasted, but the fat seemingly remains. It, however, appears dry, dead white, and brittle, or shining with water, and in its nature it is completely altered, for it does not melt or inflame like an unctuous substance, but when thrown on the fire crackles, and blackens to a cinder. Very little blood is found in the animal, and it is pale and thin, resembling water tinged with blood rather than blood. The bones are remarkably brittle.

Causes.—Where the pasture is soft and tathy, without a due proportion of heath, ling, &c. the rot is always the consequence; and after a severe and frosty winter, when sheep have suffered much from hunger, cold, &c., the rot sets in upon soils of almost every description; but in proportion as the soil is soft and rotten of itself, so is the number of rotten sheep. Hence some people have been led to consider the rot as of two kinds, *viz.* the *querney*, or *black rot*, proceeding from foul feeding, and the *hunger rot*, from an absolute deficiency of food of every kind. The only circumstances, however, in which any distinction between them is pointed out, are, that in the querney rot the animal is often apparently fat when it dies; while in the hunger-rot it is always completely emaciated; and that those which rot from the softness of their pasture are irrecoverably lost, while those which rot from hunger, or bad usage, more frequently seem to recover, and become apparently tolerable, though never good sheep. They are, however, not to be depended upon, and gradually drop off, season after season. Mr. Scott says, that in the hunger rot, there is no poke, while, on the contrary, Mr. James Hog states, that a very lean, rotten sheep is most apt to have the poke.

Others speak of many different kinds of rot, and distinguish them by different names, as the *cor* or *heart-rot*, the *fell-rot*, the *bone-rot*, and other rots; but Mr. Beattie and other intelligent farmers are of opinion, that all the different appearances in the body of the animal, are but different symptoms of the same disease, and are all derived from the same cause.

For the sake of perspicuity, however, the causes which contribute to the production or prevalence of the rot may be considered as depending on the soil, on the weather, and on the animal itself.

In the course of this treatise, many facts have been recorded, which prove the very great influence of the soil on the constitution and health of the animals which pasture upon it: in no instance, however, is this influence more conspicuous than in the production of the rot. It is well-known, that the constitution is so dependent on the soil, that in different hirsels, it varies as much as the food on which they pasture. Sheep bred where heath, bent, ling, deer-hair, thyme, &c. abound, though generally smaller, are not only infinitely superior in point of the flavour of their mutton, but far exceed in strength of constitution those bred in moist, wet, boggy land. On the latter of these pastures rot is endemial, on the former individuals are carried off by sickness; and it is remarked, that in farms subject to the one of these diseases, the other is almost unknown. On this subject Mr. James Hog has fortunately enabled me to quote a letter written to him by Mr. Bryden of Aberlosk, whose improvements in sheep farming form a kind of epoch in the history of the rural economy of this country.

"Concerning the rot, of which you are so anxious to learn every particular, and why it is peculiar to our soft grassy lands, I have jumbled together the few suggestions which follow, for your consideration.

"It is a general observation, that wherever there is a rapid growth, the decay is proportionally so, and in all places where growth is slow, decay is slow also: and all vegetable productions that have a slow gradual growth, and permanent duration, are productive of similar effects on the animals that feed upon them; while, on the contrary,

trary, such animals as feed on herbs and grasses that have a rapid advance and sudden decay, are so much influenced by it, that their bodies partake much of the nature of their aliment. Of the truth of this observation, a survey of the various animals of our own country, will fully convince you; and when you consider the following theory, this will account for the circumstance of the rot being peculiar to soft grassy lands, and also, in part, for the prevalence of that nervous disorder, called the Trembling, or Thwarter-ill, among sheep which pasture on heath, broom, and other herbage of astringent qualities and permanent duration; and it is a fact, that changing sheep from one of these walks to the other will prevent the disease peculiar to each.

" For as to the rot, I maintain, that it is always occasioned by a too quick transition from fatness to leanness; and though this opinion may be supposed new, it is nevertheless correct. There never were any sheep known to rot, while they continued at good, equal maintenance, unless otherwise abused; and none ever will rot, kept on pasture which does not feed them very fat, or allow them to fall away below a medium."

The quality of the food in the autumnal quarter, has a more immediate influence in tendering their constitution, than at any other period. It is then they should acquire that strength and hardiness with which they have to struggle with the rigour of the ensuing winter, the trying blasts of backward spring, and the still more searching duties of a nurse: consequently, if they be allowed, or compelled to fatten themselves up with soft unsubstantial nourishment, which loosens the bowels at this improper season, and relaxes the whole system, nothing is to be expected, but a great waste of body through the winter, and a tainted constitution in the spring.

Although some sorts of grass are certainly more dangerous than others, and some are even considered as having a tendency to prevent or cure the rot, yet the very same plants, which in certain circumstances rot sheep, by a different management are perfectly innocent. All grasses which are remarkably rank and luxuriant, are called *tath*, by the stock farmers, who distinguish two kinds of it; *water tath*, proceeding from excess of moisture, and *nolt tath*, the produce of dung. The latter is darker coloured than the former, but their softness, luxuriancy, and tendency to induce the rot, are nearly the same. Water tath is the produce either of lands naturally too moist, of wet seasons, or of accidental or artificial flooding. Nothing is so apt to induce the rot, as the grass which grows in low marshy grounds, awald lands, and around the heads of springs, especially on the north side of hills, so much so, indeed, that such pastures were formerly considered as naturally rotten, and rejected and shunned by all intelligent sheep farmers.

Rot also prevails most in wet seasons, especially if the weather prove soft and mild, about the latter end of autumn. The long fleeces of the sheep are not only drenched with rain, if they be not provided with sufficient shelter, but a very soft and tender tath rushes up, the influence of the sun is small, and sharp frosts commonly succeed, which waste with rapidity the newly acquired substance. Besides, bog ground is, for the most part, covered with sprit, of the smaller sort of which they make what they call *hog hay*, for young black cattle; and of the coarser sort, thatch for covering their houses. In wet seasons this shoots up to a great length, and is apt to lie down in July, and to rot afterwards. When this is the case, about September, there arises amongst it a light-coloured, soft, watery after-growth, which continues growing, until it is withered by the frost, and which is one of the most pernicious foods.

Accidental inundations, as well as artificial flooding, operate, not only by soaking the ground with moisture, but also by the sand, mud, slime, or ooze deposited among the roots of the grass, and which, when sufficiently watered, act like manure, and greatly promote the growth of tath. Flooding, however, is not equally dangerous at all times. If a rivulet should overflow its banks about Whitsunday, no bad consequences will follow, unless the succeeding season prove wet. But the verdure, however early, which rises on the banks of rivulets that have been inundated in the spring or winter, is sure, according to Mr. W. Hog, of rotting the sheep which habituate themselves to it. Mr. Singers, however, tells us that the danger is greatest in harvest, lessens in winter after the frosts have set in, and is least of all in spring. The character of some sheep farms was almost blasted by some pieces of low grounds which rotted the sheep in harvest, from being liable to be summer flooded. Mr. Keir, at Milnholm, near Langholm, suffered from pasturing sheep on lands which were flooded after the removal of the hay in a dry season, when the soil seemed to need it, although the water was allowed to flow only for a few hours. Mr. Robson, Hamilton's buildings, near Wooler, also has on his farms a piece of rotting ground, that brings on the flukes also, which he cannot venture to pasture with sheep towards the close of the season, till it first has had two or three nights of frost, and then he considers the danger as considerably reduced.

Dung greatly promotes the growth of very rank tath; hence allowing horses and black cattle to pasture among sheep is injurious, and as this is most frequently practised in soft, rough, boggy lands, which are fittest for black cattle, it is still worse, for they break the surface of the ground with their feet, and bring up mire and dirt, which taints the grass.

Another cause inducing rot, is breaking up large fields for corn, in the sheep-walks, and after they have been quite exhausted by cropping, laying them out again for pasture. If the first summer thereafter happens to be dry, very little, if any thing, grows upon them; but if it proves wet, there is also very little grass, but a great deal of sorrel, chickweed, and other weeds and trash, which the sheep are very fond of, and are full as soft, watery, and as injurious as tath. The consequences are often very bad, and as the ground is never quite sound, until it is covered with the same thick, short grass, and regain the same surface it had before it was broken up, it will require five, and in some places, seven years before it recovers.

There is still another cause which often occasions great loss by rot among Highland stocks, and that is, when sheep are severely pinched with hunger in a storm. This, as has already been stated, is sometimes considered as a distinct species, under the name of *Hunger rot*,

rot; an opinion which Mr. Beattie thinks should be received with some limitation.—It is certainly true, that, in soft grounds, the rot is apt to break out with most violence after the sheep have been starved in a storm; but when they are so famished, they devour the tops of rushes, broad bent, and every thing that appears above the snow, and when they get down to the soil, after casting the snow, they gnaw up the roots of the grass, and break the very surface of the ground, swallowing sand and mud, and whatever comes in their way; so that, although it is undeniable that the rot often breaks out most violently after a storm, and that it will then appear on ground where it is unknown at other times, "I am still slow in believing," adds Mr. Beattie, "that hunger itself, unassisted by any deleterious food, will induce the rot. I rather think they are poisoned by being reduced to eat such unwholesome food as they will not touch at any other time; for in the course of my experience, I have several times known sheep, when sheltered by a rock, where they could get nothing, overblown with snow, and lie there until they had endured hunger beyond credibility, and yet be got out alive, and prove quite sound afterwards. I have likewise known sheep on a very sound ground, where the surface was firm, and no tath or bad food to be got, so reduced by hunger in a storm, that they died of downright hunger, and yet as free of rot, as the day they were lambed, and the stock that survived, proved as sound as any stock in the kingdom."

Other misfortunes affect only individuals; but a hard and severe winter brings a whole stock under its ravages; hunger and fatigue waste their strength, and subdue their vigour; the excessive frosts benumb and decay the very springs of life, which, for want of fat, are now exposed to the nipping gales.

Overstocking operates nearly in the same way as a storm, as the more they are straitened for food, the nearer the surface they will go, and the more sand, mud, and roots of tath will they swallow; and although it seems not easy to determine, whether mud of itself will introduce the rot, as sheep never swallow any of it, but when they have the tainted roots of the tath along with it, yet as it is a most unnatural food, we may certainly conclude that it is unwholesome.

Overstocking spoils sheep of all ages and descriptions. Hungering in summer ends in starving in winter; and in long continued severe weather, the whole may be in danger of being lost.

Whatever injures the constitution, or tends to debilitate sheep, also renders them more liable to be affected with the rot. Nothing contributes more than a course of changeable weather from one extreme to another, to waste sheep, and nothing is more difficult to guard against, which has given rise to the proverb

> Mony a frost, mony a thow,
> Soon maks mony a rotten ewe.

Overheating sheep in autumn by severe dogging, or rash and inconsiderate management, has also the worst effects in breaking their spirits, and wounding their constitution. Ever afterwards, they feed only on soft tathy meat, which always insures rot in the spring. Ewes, and especially gimmers, which have been debilitated by being milked, or sucked too long, commonly suffer. The rot may be also considered as an hereditary disease, at least the lambs of tainted ewes are never sound.

The rot never affects sheep which have plenty of food and good shelter. Hence pet sheep never suffer from it, although their food is often of a very improper nature. It is almost unknown on hard dry sheep lands, where the water runs off as soon as it falls; and sheep that have access to the shores of the sea, or to salt-marshes, are hardly troubled with it. On walks where heath abounds, it is not common, although it is frequent on green hills in the same neighbourhood, equally dry; nor is it very prevalent on mosses, notwithstanding their excessive moisture. "This remark," says Mr. Singers, "may account for the well-known fact, that in the Highlands of Scotland, the rot is little known, although the climate is moist, and there are great tracts of wet soils; but in these walks there is plenty of heath, an immense extent of sea shore, along the vast and numerous arms that run from the sea, and intersect that mountainous district, and very large tracts of dry rocky sheep-walk interspersed. These fortunate circumstances render the pasture of the Highlands of Scotland sounder from rot, and safer from storms, than the green walks of the Cheviot hills, or those of the head of Roxburgh and Dumfries-shire."

"The coincidence of rank tath grass, wet soils, summer-flooded lands, soft grasses in rich land, and moist seasons, in producing this disease, is striking. I remark two circumstances, in which all these causes of rot seem to coincide. One is a superabundance of fluid in the food; and the other is a deficiency of free sun and air, to elaborate the plants. Both these characters must constitute real defects in the grass; and they are both apparent, less or more, in the tath rank grass of all sheep-walks; in the produce of soils naturally too wet, in that of lands pushed into excess by summer floods; in the soft grasses that rise thick and quickly in rich soils, containing too much moisture; and in the general growth of wet seasons. Even in overstocked pastures, there are tufts of rank grass arising from animal manure lying in superabundance on the ground, which must be liable to the two objections above mentioned. When vegetables rise too fast, and too thick, they are never wholesome; over-manured corn or potatoes are unpleasant and unhealthy food: even the trees that grow in soils excessively rich, and want free sun and air, become what the woodman calls crashy, or spongy and brittle in the grain, and unfit stand in durable work.

"These defects in the vegetable substance and organization, are only comparative. The grass that rots sheep, is also unfit for posting horses, and breaks their wind: it even retains this defect, after it has been made into hay; yet in this state, it may answer working horses, whose pace is slow, and exertions moderate. But for milk cows, it has not been ascertained, that sheep-rotting grass is in any degree injurious. The excess of fluid adds to the quantity of the milk, and is thereby drained off; but the quality of the milk is confessedly inferior.

"It is well known, that the combined influences of light, heat, and air, are necessary to perfect vegetable substances; and even to maintain their health and specific characters. It is also certain, that in order to have them sufficiently prepared in the laboratory of nature, they must not be unnaturally pushed forward into rankness, but must have proper time allowed them to vegetate. A single stole of corn growing in a dung hill,

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has plenty of air, light, and heat; but it becomes rank by excess of manure, and rots instead of ripening. Excess of fluid is manifest in all the kinds of grass that induce sheep rot; they also appear to be defective in fibre, as excess of fluid seems to imply, and their softness further indicates. But assuredly the juices and parts are imperfect in other qualities also; their rankness appearing to impede that regular process of nature, in the course of which all their parts arrive at maturity. The sap appears to be propelled to excess; while the necessary secretions, transpirations, and absorptions, are at the same time disturbed.

"These defects in the grass of summer-watered lands, may probably become more conspicuous, by reason of the extraordinary vegetation that takes place at this period, and pushes the rising grass into higher degrees of excessive luxuriance. Plants watered in autumn extend their roots greatly, indeed, and are thereby in readiness to push up vigorously next spring, but the ascent of sap in the stalks is checked by the season. Spring watering both extends and feeds the root and stock; but nature at this season requires the large supplies of moisture with which the earth abounds, for carrying up the stalk and leaf of grasses; whereas in summer, she requires more sun, in order to form and mature the seed. Accordingly we see, that a very dry spring and moist summer appear to invert the demands of nature, and are fatal to the crops of grass, in point of quantity and quality also. It must also be observed, that the leaves of plants transpire most early in their season, and gradually lose a portion of this power; they must therefore be injured more in summer by excess of fluid, than in spring, when they can more certainly throw off the excess. If these causes are not thought sufficient to explain the superior comparative defects of summer-watered grass, above those of grasses watered in autumn or spring, it should be remembered, that though the fact is well known, the attempt to explain it is almost wholly new. I shall therefore add only the following remarks: that though moderate waterings are useful and necessary to feed grass in summer, yet excess of water destroys it more quickly at that season than at any other; and excess of water, together with stagnation of air, and obstruction of light, at this period, are so visibly injurious to the quality of soft grasses, as very soon to reduce them to a putrid mass.

"But there seems to be another obvious cause of danger to sheep from summer-flooded lands, pastured by them immediately afterwards. The spawn or eggs of the liver fluke are most probably conveyed upon the grass by this operation, and afterwards taken into the stomach with it. This may readily happen by summer watering; whereas, there may be no spawn to float in the fields in spring, and if wafted thither by harvest waterings, the frosts of winter may destroy the animals before the spring following. The *fasciola hepatica* must be bred from spawn conveyed into the seat where it is found, by the blood, or some other channel; for we cannot admit of equivocal generation in the production of this insect; and I see no way of accounting for it more naturally than the above. Rotting grass in general, and particularly summer-flooded pastures, eaten off immediately thereafter, operate probably, not only to prepare a nidus for the fluke, by rendering the liver of sheep diseased, as weak stomachs loaded with phlegm, breed worms in children; but also to convey the spawn of the insect itself into the sheep's body. The admission of this account of things would furnish an obvious explanation of certain interesting facts relative to the rot, for which no cause has yet appeared.

The deleterious effects of rot grasses upon sheep, may be farther illustrated by the following observations. The grass always loses a very great proportion of weight when cut green and dried; not less, generally speaking, than seventy parts out of a hundred; when sound healthy grass, taken at the same time, loses only about sixty parts out of an hundred; or less, according to the degree of its maturity. This excess of watery fluid in rot grasses accounts for the observation that has been often made of them, which is, that they scour sheep, rather than feed them; an effect which is very injurious to these animals.

"It ought also to be noticed, that a ewe that is giving suck to a lamb, can safely bear a greater proportion of fluid in her food, as the milk operates like a drain for it; which may counteract the dangerous effects of excess in this particular, as happens to a milk cow; but cannot prevent the bad effects of grass, in other respects unhealthy. Only, it is possible to believe, that the strong appetite and digestive powers of an animal giving milk, may overcome dangers in the quality of its food, which might otherwise have manifested bad effects. And if ewes and lambs be in less danger than other sheep, from grass having a tendency to produce the rot, we may probably find this a rational account of that distinction." *Mr. Singers.*

It is not exactly ascertained, in how short a time a sheep may be infected by feeding upon tainted grass.

"I was upon a reference," says Mr. Beattie, "when a witness deposed, that he had known sheep tainted in one night, and assigned as the cause of his knowledge, that he saw a parcel of wedders bought by three men off a very sound ground; the men divided them into three lots; the grounds they were to pasture them upon were all equally sound; but one of the lots having farther to go, did not reach its pasture that night; it was therefore inclosed at dark, in a cow-fold, and taken out very early next morning, and put upon its pasture. Several of that lot proved unsound, but none of the other two lots. A night seems to me rather a short time, but I have seen some instances, which incline me to believe that they will catch it in a week, although for the most part, it certainly requires a longer time." On this subject, Mr. Singers quotes the following fact from Mr. Arthur Young. Twenty South Down ewes were lost by rot, which got into a summer-flooded meadow, in Sussex, only for a single night before dropping their lambs, while the other ewes which were kept out till they had their lambs, which happened about Christmas, or soon after, were then admitted into the same meadows without danger.

With regard to the season in which sheep are most exposed to the danger of being tainted, Mr. Beattie has the following observations. "In summer, as the influence of the sun is strong, unless it proves extremely wet, there is not much danger; in harvest, especially the latter end of it, if the weather is wet, mild, and growing, the danger is very great; it is equally so in the beginning of winter, as long as the weather continues soft and growing; but so soon as the frost sets in fairly, the danger is over; the tath, it may be remarked from its softness, is now shriveled and withered almost to nothing, the noxious moisture is quite exhausted; and the sheep are not so fond of it; so that unless they are compelled to tear up the roots of it in a storm, there is little danger to be apprehended from it in winter. But in spring, especially in March and April, if the weather is soft, the danger is great; for the sheep are commonly in a low state, from coming through the winter, the ground is then bare, and if tath arise, it is young, soft, and watery, and the sheep, from scarcity of food go to the very roots of it; and after an ewe has lambed, she is often so straitened to support herself and the lamb, that she devours all she can meet with, and is very apt to catch the infection."

"It is impossible to say, with any degree of precision, how soon it will discover itself after infection; it is so various in different sheep, different grounds, and different seasons. Some that have contracted the taint in the end of harvest, will shew evident marks of it in February, and die soon; others will live till Whitsunday, and die when the weather turns warm. Some of them will seem to be tolerable sheep as long as they are unclipt, and after clipping will cease to thrive. If the taint has been pretty general, they will continue dying through the whole year; but if it has been but slight, and a dry summer should succeed, their constitutions seem to recover, and they will live for several years, and take on flesh, and thrive just as well as sound sheep; but although the disorder is dormant, it is still in their frame; for which reason, experienced shepherds, when they have any suspicion of their stock being tainted, draw out and sell many more of them than at any other time; neither do they thus any injury to those that buy them for feeding; for when they are in this state, they will feed, in warm fine pasture, nearly as fast as any sheep; but when they remain upon cold Highland grounds, they can never endure hunger, hardships, and winter storms, like sound sheep, and still die rotten at last."

TO BE CONCLUDED IN OUR NEXT.

List of Patents for Inventions, &c.

(Continued from Page 288.)

JOHN DICKINSON, of the parish of Saint Martin Ludgate, in the City of London, Stationer; for certain improvements on his patent machinery for cutting and placing paper; and also certain machinery for the manufacture of paper, by a new method. Dated January 19, 1809. Specification to be enrolled within six months.

GEORGE FINCH, the younger, of King-street, in the parish of St. Anne, Soho, in the county of Middlesex, Orris Weaver; for certain methods of manufacturing various kinds of metal laces, so as to imitate gold and silver laces; and also of manufacturing gold and silver open laces. Dated February 4, 1809. Specification to be enrolled within one month.

THOMAS POTTS, of Hackney, in the county of Middlesex, Gentleman; for a new process of freeing tarred ropes from the tar, and rendering it fit for the use of the manufacturer. Dated February 4, 1809. Specification to be enrolled within six months.

FREDERICK ALBERT WINSOR, of Pall Mall, in the city of Westminster, and county of Middlesex, Esquire; for certain improvements upon his former patent oven, stove, or apparatus for carbonising all sorts of raw fuel and combustibles, and reducing them into superior fuel of coke and charcoal, as well as for extracting and saving, during the same process, the oil, tar, pyroligneous vegetable acid, and ammonial coal liquors; and for extracting and refining all the inflammable air or gas, so as to deprive it of all disagreeable odour during combustion, and rendering the gas itself salutary for human respiration, when properly diluted with atmospheric air. Dated February 7, 1809. Specification to be enrolled within two months after the conclusion of the next Session of Parliament.

WILLIAM CONGREVE, of Cecil-street, in the Strand, in the county of Middlesex, Esquire; for a mode of construction or arrangement for any building, so as to afford security against fire, with other advantages. Dated February 7, 1809. Specification to be enrolled within one month.

ARCHIBALD THOMSON, of Manchester, in the county palatine of Lancaster, Engineer; for certain improvements or machines applicable to various kinds of spinning. Dated February 7, 1809. Specification to be enrolled within four months.

WILLIAM EVERHARD BARON DOORNIK, of Old Lisle-street, Leicester-square, in the county of Middlesex; for certain improvements in the manufacture of soap to wash with sea water, with hard water, and with soft water. Dated February 7, 1809. Specification to be enrolled within six months.

JOHN STEAD, Leith-walk, Edinburgh, Card-manufacturer; for a method of manufacturing cards which are employed in the carding and spinning of flax, tow, wool, cotton, and silk, so as to combine the quality of a fine

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fine card with the strength of a coarse one. Dated February 9, 1809. Specification to be enrolled within one month.

JAMES GRELLIER, of Aldborough Hatch, in the county of Essex, Esquire; for a building of a peculiar construction, for the purpose of burning coke and lime, whereby the superfluous heat of the fire used in burning the coke is applied to burn the lime; and also, whereby such fire may be rendered perpetual, and which he denominates, *The Union and Perpetual Kiln.* Dated February 13, 1809. Specification to be enrolled within five months.

STEPHEN HOOPER, of Walworth, in the county of Surrey, Gentleman; for a thermometer, or machine for ascertaining the heat of bakers' ovens, and various other purposes. Dated February 13, 1809. Specification to be enrolled within one month.

DAVID MEADE RANDOLPH, a citizen of Virginia, in the United States of America, but at present residing near Golden-square, in the county of Middlesex, Merchant; for a method of manufacturing all kinds of boots, shoes, and other articles, by means of a substitute for thread made of hemp, flax, or other yarns. Communicated to him by a friend and correspondent residing within the United States. Dated February 21, 1809. Specification to be enrolled within one month.

JOSEPH HETT, of Stratford, in the county of Essex, Calico Printer; for a method of producing fast greens on cotton, and various other articles. Dated February 21, 1809. Specification to be enrolled within one month.

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THE REPERTORY OF ARTS, MANUFACTURES, AND AGRICULTURE.

No. LXXXIV. SECOND SERIES. May 1809.

Specification of the Patent granted to EDWARD STEERS, *of the Inner Temple, Esquire; for a new Method, directed by Machinery, of using the Screw, by which its mechanical Power or its Motion is increased.*

Dated March 1, 1809.

With a Plate.

TO all to whom these presents shall come, &c. NOW KNOW YE, that in compliance with the said proviso, I the said Edward Steers do hereby declare the following to be a description of my invention of a new method, directed by machinery, of using the screw, *viz.* The new method of applying the mechanical power of the screw is, in the first place, by the screw and nut being made to revolve together either in the same or in a contrary direction. If they turn in the same direction, the one somewhat faster than the other, an increase of power is obtained; if in a contrary direction, there is an increase of motion produced. In the second place, the new method is, by two screws, placed opposite to each other, revolving together in the same circular direction, or in a contrary direction, their nuts being fixed; or, in the third place, by their nuts revolving together, the screws being fixed.

The machinery necessary to direct the operation of this new method, must be such as will turn the screw and nut, or the two screws or their nuts, one quicker than the other, in the same direction, or such as will turn them in a contrary direction. There are various modes of producing these effects, which an ordinary knowledge of mechanicks will suggest. One mode the following description and the annexed drawing will explain.

The wheels A and B, fixed upon the nut A and screw B (Plate XIV. Figs. 1 and 2,) are of the same diameter, but the wheel A has one tooth more than the wheel B; they are turned by the same pinion C. Now, suppose the wheel A to have 101 teeth and the wheel B 100 teeth, then, when the wheel A has made one revolution, the wheel B will have made one revolution and the one-hundredth part of another, consequently the screw will have risen one-hundredth part of the distance between two of its threads, and the increase of power obtained by this new method will be in the proportion of 100 to 1. Now suppose there be another screw D and nut E revolving round a pin in the centre of the upper part of the screw B, and suppose to the nut E be fixed a wheel having 102 teeth, and to the screw D a wheel having 101 teeth, then, when they are turned round by the same pinion, as soon as the nut E has made one revolution, the screw D will have made one revolution and the one-hundred and first part of another revolution, by

which

Fig. 1.

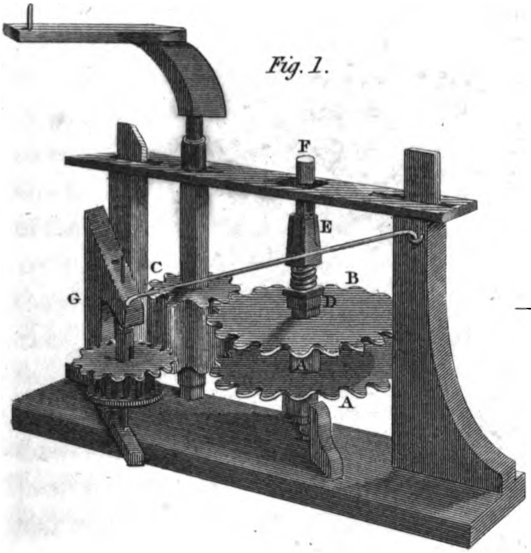


Fig. 3.

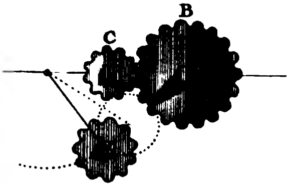


Fig. 2.

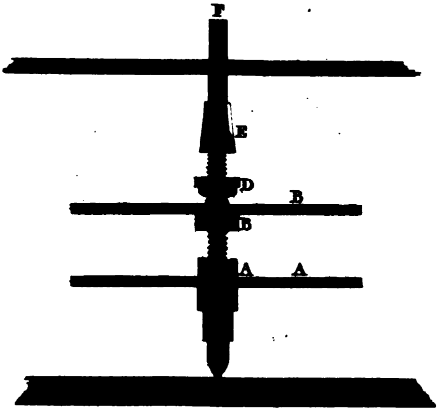
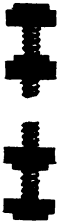


Fig. 4.



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which operation the nut E will be lowered the one hundred and first part of the distance between two of the threads of the screw. The turning of the two first-mentioned wheels then has the effect of raising the nut E the one-hundredth part, and the turning of the two last-mentioned wheels the effect of lowering the nut E the one hundred and first part of the distance between two of the threads of the screw; consequently, when the wheels are turned all together once round by the same pinion, the effect will be that of raising the end F the ten thousand one-hundredth part of the distance between two of the threads of the screw, and the increase of power obtained by this new method will be in the proportion of ten thousand one hundred to one. The two wheels in the small frame G, which is attached to the large one by hinges, are to be used when it is required to produce an increase of velocity: for this purpose the pinion C must be raised upon its axis, so as to be disengaged from the wheel A, and the wheels in the small frame must be brought in contact with the pinion C and wheel A, (see Figs. 1 and 3,) so that the pinion C may turn the upper wheel in the small frame, and the lower wheel in the small frame turn the wheel A: the effect will be, that of turning the wheels A and B in contrary directions; the screw and nut will move in opposition to each other, and the end F will rise by this new method with increased velocity.

Fig. 4 represents two screws, with their nuts placed opposite to each other. Now suppose the screws to be turned by machinery similar to that already described; their nuts being fixed, then, if they be turned in the same circular direction, one screw will advance and the other recede; or if the screws be fixed, and the machinery applied to the nuts, then one nut will advance and the other recede; but, as the motion of one will be quicker than that of the other, they will gradually approach, and there will be an increase of power procured, as was explained when the screw and nut were supposed to revolve together.

In witness whereof, &c.

Specification of the Patent granted to JOSEPH ANTHONY BERROLLAS, *of Denmark-street, in the Parish of Saint Giles in the Fields, in the County of Middlesex, Watch-maker; for a Method of making infallible repeating Watches.*

Dated October 31, 1808.

With Engravings.

TO all to whom these presents shall come, &c. NOW KNOW YE, that in compliance with the said proviso, I the said Anthony Berrollas do hereby declare that the nature of my said invention, and the manner in which the same is to be performed, are particularly described and ascertained as follows; with reference to the plates, figures, and drawings numbered 1 and 2 in the margin of these presents, and the letters therein mentioned and thereto affixed, and which are given in order, the more fully to explain and disclose the nature of my said invention; that is to say:

First. The outside of the watch resembles common watches, except the pendant T, (Plate XV. Fig. 1) which is mounted with a button, consisting of two parts, C and X; the lower one X does does not move, and the upper one C, having an endless screw annexed to it, turns round and comes out to the extent of four turns, and is cut in four turns and a half. The upper part of the button C, being turned to the right, screws off from the lower part X, and operating upon the hour rack A can be continued to be unscrewed until it has struck the hour which the hand indicates, when it cannot be further unscrewed. The same part C, being afterwards screwed to the left to bring it back again to join the lower fixed part X, operates upon the quarter rack B, and quarters are struck in the same manner as the hours until the part C is completely joined to the part X. The piece W draws piece B back to its former station.

Secondly. The movement of this watch is the same as that of a common watch that is not a repeater, see fig. S, No. 1. The wheel-works are of the same height, which is not the case with common repeaters, in which the operation of striking being occasioned by a work in the movement composed of five wheels, five pinions, and a barrel and main spring, necessarily cause the movement wheels to be smaller, and this injures the solidity of the work, and augments the labour. The sort of escapement to be used is optional. The hammer which strikes the hours and quarters is the only additional piece which is in the frame of the movement, and which distinguishes the infallible repeating watch from a common watch not a repeater.

Thirdly. The motion is composed of three principal parts, the first, A, No. 2, contains the hour rack; the second, B, the quarter rack; the third, C, the pendant and endless screw. The piece C turning on itself in manner pointed out No. 1, ascends perpendicularly, and is kept in that perpendicular direction by the piece E, which performs two objects, for the interior of it forms the catch-work of the screw, whilst the exterior is fixed by

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by two screws on the pillar plate, and when the piece C is turned, acts upon the piece A, and gives it a circular motion, first by means of the piece D D, whose interior part is caught in the notch at the extremity of the piece C, while the exterior part of it is caught in the piece A; secondly, by the piece F, which holds the piece D D in a groove; thirdly, by the piece G which is fixed to the pillar plate with three screws, and under which the piece A is fixed by means of a pivot on which it moves. The piece A being thus moved, catches, by means of twelve teeth cut in its interior part, the piece H, which puts in action the hammer Q (see the print, No. I.), which strikes on the piece R, which is a bell spring fixed by two screws to the extremity of the pillar plate. The piece A passes under the piece K, which is a brass bar with two screws to keep piece A from rising. In order to give a free and steady motion to the piece A it is operated upon by a pivot which is fastened to a spring U placed in the inside of the pillar plate, and which pivot, passing through a hole in the pillar plate, causes a steady friction under the teeth of the piece A. The piece A is regulated by the piece M, which is the same as the star and hour snail in common repeaters, and performs the same functions. The click of the star N and the spring of O communicate in the same manner as in common repeaters. The piece M operates on the piece A by means of the piece V fixed by a screw in the piece A, and thus moves the rack in the piece A forward as the hour snail moves forward. The quarter piece B which is fixed on a pivot falls on the piece P, and is brought into its place again by the piece A, by an easy friction, the design of which is to draw back the piece B when the piece C is turned from right to left, and to bring it back upon the rising of the quarters piece J, when it is turned from left to right to obtain the quarters. It is forced upon the snail of the quarters by the spring L fixed on the pillar plate. At the same time that the piece B is brought back over the piece J, it communicates by a stop with the snail of the quarter piece P which snail is the same as in common repeaters. The piece J and the piece H are kept in their respective places by two fixed springs, viz. that of the piece H upon the plates, and that of the piece J on the piece K. The pieces J and H are on the same pivot, which forms at the same time the arbor of the hammer. They obey the motion of the piece C as described above.

And in order the better to elucidate the nature and superior utility of my said invention, I do make the following observations, that is to say:

Observation the first. The old repeaters contain five wheels more than the common watches, besides five pinions and a barrel and main spring, which are all necessary to put in action the motion; they also have two hammers to distinguish the hours from the quarters. Whereas, the new repeater is composed of the common plain movement and wheel-work, with the addition only of a hammer, which is placed in an insulated situation, having no communication whatever with the wheel-work.

Observation the second. The old motions being so very complex, are in their nature liable to be out of order from the slightest cause, because the chain of the motion which winds the main spring of the repeating work is easily broken by means of the pressure, its very structure, and its attendant friction, and lastly, because the action of it depends upon the main spring and wheel-work, the latter of which is apt to be disordered, and the former snaps, and breaks of itself. Whereas the new motion acts in itself, and has no dependance on wheel-work, or any other piece that is subject to be broken; an endless screw sets the two chief parts in motion which produces the effect of striking the hours and the quarters, and all the other pieces are designed only as collateral support to the two principal ones.

Observation the third. From these observations, the simplicity of construction in the new repeater, is evident, and of course a great diminution of useless expense to the manufacturer. And I do hereby declare that my said improvements are capable of being applied in a variety of other forms agreeably to these presents, which will readily occur to any competent workman who shall have perused the same.

In witness whereof, &c.

Specification of the Patent granted to JOHN BROWN, *of the Parish of Saint Andrew Hubbard, in the City of London, Stationer; for Improvements in the Construction of a Press for Printing Books and other Articles, part of which may be applied to Presses now in common use.*

Dated June 2, 1807.

With a Plate.

TO all to whom these presents shall come, &c. NOW KNOW YE, that in compliance with the said proviso, I the said John Brown do hereby declare that my said invention is described in the drawings and description thereof hereunto annexed.

In witness whereof, &c.

Fig.

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A, Fig. 1, (Plate XVI.) is a press made of cast iron, (or any other fit material,) which is cast with B, in one body. C is a bed made of cast iron, or any other proper material, which must be faced true, for the types to lay on, as at I, Fig. 2. D is the follower, which gives the pressure on the types, and is fixed to the screw. E is a guide for the screw, with a hole in it to receive the blank part of the screw, being screwed or otherwise fastened to the side of the press. F is a bevil wheel and pinion, with a handle to give motion to the same fixed on a spindle or shaft, on the top of which, G is a rigger, sheve, or cylinder, with a catch or clutch to throw it out of geer when required: the rigger being fixed on a round axis, the clutch on a square, and the rope fixed to a lever on the screw. H the rope keeling, or winding round the rigger, sheve, or cylinder, after the pressure is given, strikes out the catch, and lets the screw revolve back on the round axis by means of weight or spring. I, Fig. 2, is a cast iron bed or platform, being faced true for the type to lay on: this cast iron bed slides out below the roller or cylinder, K; which roller or cylinder revolves round, and feeds the types with ink. This roller or cylinder is covered with flannel, or any other proper elastic substance, and then is covered with parchment or vellum, or other proper materials, to prevent the ink from soaking too far in, and likewise to give it a spring, and afterwards is covered with superfine woollen cloth, (or any other fit material,) additionally sheared if required, for the purpose of receiving the ink to supply the types. L is a large barrel or cylinder, and also a small barrel or cylinder. The large barrel or cylinder having received the ink from a trough, M, underneath it, the small barrel or cylinder rolls on the large barrel or cylinder, and distributes or spreads out the ink on the face of the large barrel, L; or it may be necessary, with the small barrel or cylinder, occasionally to use a brush to distribute the ink, or lay the ink on the large barrel. The large barrel or cylinder feeds the barrel or cylinder K with ink, and the barrel or cylinder K revolves round and feeds the types by the motion or movement of the spindle, which moves the bed I. N is a platform on which the types are laid, and the platform or types slide in and out under the screw by turning the handle and spindle P, Fig. 3, which gives motion to the large and small barrels or cylinders L, and also to K, which feeds the types with ink. O is a platform for a loose moveable frisket; which frisket is connected with, and slides in and out at the ends of the iron bed, D, for the purpose of conveying the paper over the types. P, Fig. 3, is a spindle and a handle for moving the bed I, with the types thereon; which handle and spindle give motion, by means of a strap, or any other convenient thing, to the barrels or cylinders K and L.

I also apply the barrels or cylinders K L (being my principal improvement,) to presses now in common use, by means of a fly-wheel and traddle, which give motion to the two barrels or cylinders L, and distribute the ink which is reserved by the barrel or cylinder K, as above specified, and which barrel or cylinder may be rolled over the types, to feed them with ink, either by the motion of the hand or fly-wheel, or in various ways, well understood by every competent workman.

My first improvement is on the press; my second improvement consists in my using barrels or cylinders for feeding the types with ink; and my third improvement consists in the loose frisket, and the mode of using it.

A Treatise on the Diseases of Sheep; drawn up from original Communications presented to the Highland Society of Scotland.

By ANDREW DUNCAN, *Jun. M.D. F.R.S.E. and A.L.S.L.*

(Concluded from page 358.)

PREVENTIVES.—The most deadly lands have become comparatively sound, by proper draining. After this operation, many parts of a farm, which only produced spirits and coarse grass, will soon become covered with the finest verdure. Wherever it is practicable to draw off great bodies of water at once, the method of the celebrated Mr. Elkington, of Warwickshire, should be adopted; but in general the small sheep drain, as it is called, is preferred, sloping gently across the declivities of the wet soils. This, when properly executed, never fails to be of great advantage; and it is not expensive, as it may be executed for a penny every six yards.

To preserve the small sheep-drain from destruction, it becomes necessary to destroy the moles. They are very pernicious in sheep pasture, and work much in wet as well as in dry land. Particularly where it is drained, they destroy much of the best grass. From the lower sides of the drains they cut passages to the surface of the soil, by which the water escapes, while the mole-hills being washed over the surface, act as manure in raising tath. The drains themselves in time get choaked, and perfectly useless. The moles must therefore be destroyed, which experienced mole-catchers will do at so many shillings *per* hundred acres. Landlords and tenants are equally interested in these improvements, and should go hand in hand in them. Thus, when Archibald Irwin took the once rotting farm of Overdumfiddling from his Grace the Duke of Buccleugh, he engaged to drain out the rot, provided his Grace would extirpate the moles, and it is now as sound a farm as any in the country.

Low and hollow lands are often unnecessarily flooded where waters and rivulets run in a winding and crooked direction, occupying perhaps ten times more space than they ought to do. Heaps of sand also collect in various parts of their channel, which accumulate until they force the water to take a new course, and on every increase to overflow the banks, covering the neighbouring flats with sand, mud, &c. In such circumstances, the channel of the rivulet should be deepened, and made as straight as possible. Upon certain parts of the lower lying lands, where the descent for the water is very gentle, and little more than perceptible, and where a flood is sure to overflow the banks, what are called *fleet dykes* ought to be raised. These dykes may be made of turf, two and a half or three feet high, and a few yards back from the banks of the stream, for the purpose of more effectually preventing the waters from overflowing the adjacent flats. By this means a flood would have its bed sufficiently enlarged, and would also in its course be confined to its proper channel. Some small annual repairs, which the shepherds themselves might execute at their leisure, would be sufficient to keep these dykes in order.

There are circumstances, however, in which draining is prejudicial. "But I must here make a distinction," says Mr. Beattie. "If the surface is green, either bog, or soft ley, draining is a principal preventive; but if the surface is black, that is, either peat, moss, or flow, it must not be attempted, as I have found by experience it does much harm. For there is something strange in the nature of moss ground; the more water that stagnates upon it the more food for sheep it produces, and it never will produce any thing that has the smallest tendency to introduce the rot; for as it produces no grass, it can produce no tath; but only moss, ling, and deer-hair; which are not only firm sound food, but by coming so early (for the ling will draw in the middle of February, if the weather is fresh) in early Springs, will raise Highland sheep, that have plenty of them, to order, superior to sheep that feed in lower grassy lands; and as sheep pull them up by the roots, they get more benefit from the clean white roots than from the stems. These all flourish most in water, and if you drain moss ground, when you have it completely dry, it will be completely useless, as it will produce nothing at all."

On many rough boggy grounds a mixed stock of sheep and black cattle are pastured promiscuously, the latter affording some profit, but the former proving of little value.

The pernicious effects of nolt-tath have already been mentioned. The remedy is obvious. Avoid pasturing cows, and more especially horses, among your sheep. "I have found by experience," says Mr. Beattie, "that far more grounds, if properly drained, and kept clear of horses and black cattle, will keep a sound stock of sheep than is generally imagined; for although many people have tried the experiment, and failed, the reason seems to be, that they have never given it a fair trial. Ground that has been broken up with the feet of black cattle, and tainted with their dung, will, like land that has been broken up for cropping, require five, and sometimes seven years, to come fairly round; and though you free it of the nolt, so long as it has not regained a sound surface, and whilst you observe the grass of a blacker colour, you may be certain that the effects of the nolt-tath are not exhausted, and the sheep will do little better than when the black cattle were among them. When farmers observe this, they think it folly to lose the profits of their black cattle, and the sheep no better, and they bring the black cattle among them again; whereas, if they would persevere, although with some loss for a while, I think that in the end they would generally succeed."

The importance of excluding horses from a sheep-walk is also strongly stated by Mr. Laidlaw.—"Great praise is due to his Grace the Duke of Buccleugh, on this account, as well as for his other attempts to introduce a spirit of improvement into this part of the country. By express stipulation with his tenants, he obliged them to build a park for keeping such horses as were off work. Nor can this be deemed an arbitrary regulation of his Grace, for the generality of mankind, especially those whose improvements are in their infancy, are so blindly devoted to present profit, that nothing less than express stipulations will do; and when it is considered, that, after all, his Grace's lands are much below what public offers would raise them to, he may be said to lay all the improvements out of his own pocket. I have witnessed the beneficial effects of the above to be already considerable."

When sprit looks as if it would lie down it should be mown, and then the surface, being exposed to sun and air, will produce no unwholesome food. Spots of rank soft grass ought also either to be mown for hay in July, or eaten closely down at two seasons, *viz.* in Spring by the ewes and lambs, and again early in harvest by the young sheep.

"If there be water meadows on the farm," says Mr. Singers, "and the sheep be suspected of danger of rotting, the meadow ought to be inclosed, which places them at the farmer's command. In Spring he may freely pasture his meadows; if he incline to do so, they will greatly improve his ewes and weak lambs. But he must on no account water the meadow after the hay crop, for sheep feed. The main feeders and drains should be so laid out as to dry the meadows perfectly, at pleasure, which renders them even safer than in their natural state of haugh, bog, or springs; and by inclosure, and due precautions, the water meadows in England are of the first importance for the sheep, without any danger being incurred. This system is also beginning to find its way into Scotland, without occasioning any losses by rotting."

Any portion of a sheep farm which may have been unavoidably broken up for cropping, should be inclosed until it is again covered with wholesome grass.

The advantages of light-stocking are almost incalculable; it wards off the rot, and strengthens and improves the flock, which, though fewer in number, is better in quality,

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quality, and greater in value; and even if sheep in good condition should be affected by the rot, they may be disposed of in an early stage, with little or no loss; but lean sheep when rotten are useless.

When sheep are in danger of being compelled by hunger to eat unwholesome food, keep plenty of meat among their feet, and in a storm either remove them to some lower pasture, or give them plenty of turnips or hay. On many sheep farms, indeed, it would be difficult to raise a sufficient supply of turnips; but lands that rot sheep, especially since irrigation has been introduced, will always produce hay enough. In the same manner, when the Winter and Spring are dangerously moist, let the sheep have access to a stock of good sown grass hay, or to hay of dry leys, or any other well-made hay, of a fine pile, once a day, or towards the afternoon or evening. The small pickings they take of this hay are useful to correct the danger arising from excess of fluid.

If the store-master has salt marshes at command, he considers his sheep safe; or suspected sheep may be allowed to pasture along the shores of the sea, and to eat the grass impregnated with salt by the tides or spray, or the sea-weeds which they pick up within flood-tide mark. When there is no access to salt marshes or the sea shore, the suspected sheep may be removed into clean dry walks, where heath grows on a gravelly soil, and is in a proper state for eating. As aged sheep run the chief risk from this disease, and young sheep are in danger from sickness, at the same time, Mr. Singers advises to transfer the aged sheep to clean heath, and the young to bent grass, at the same season, or rather, to give each the range of the whole farm as they incline, only taking care to remove each kind, from the place suspected for inducing its particular disease, at the critical period.

"Although artificial grasses," says Mr. Singers, "in sheep walks, can never bear any considerable proportion to that natural pasture on which the flocks must depend, yet it ought not to escape our notice, that the farmer who dreads the rot may do some good by sowing out his fields with a mixture of such grasses as are considered good to prevent that disease, mixed with the ordinary pasture seeds. And when these grasses are in a proper state for pasturing, he may select any suspected animals, and admit them. For this purpose I recommend the following seeds, *viz.*

"1st. Rye grass. *Lolium perenne.* It is an early grass, and one of the soundest and most profitable for sheep and horses that has yet been cultivated. It also admits, and even requires, to be close eaten down, and that frequently. The fibre is strong, and the grass nourishing at the same time. For pasture, the farmer must avoid the annual seed; although, for a single crop of hay, the annual seed is best, and yields the heaviest crop. Nothing but ignorance of the qualities or management of rye-grass, could induce any farmer to depreciate it. Let it be regularly and closely eaten down, and it does not run to seed; or, if cut into hay, let it be mown in the flower, and no hay is more nourishing.

"2d. Rib-grass, *Plantago lanceolata.* An excellent sheep-pasture, strictly perennial, and enduring a great deal of eating throughout the season. It is a natural plant on dry sound walks, and of use to thicken the pile of rye grass, and vary the pasture.

"3d. White trefoil, Dutch clover, *Trifolium repens.* This humble but sweet plant delights in a dry sound field, properly cleaned and limed; and it is itself the delight of sheep. A mixture of it, and of the two former seeds, constitutes one of the best sheep pastures that can be formed by the industry of man. This species of clover is also perennial, and enriches instead of robbing the soil. I have generally noticed this to be the most abundant plant in sound, rich, improved pastures; but have seldom seen it in lands remarked for inducing the rot among sheep.

"These valuable seeds being provided, the following may be mixed along with them in any convenient proportion, chiefly as medicinal for the rot, *viz.*

"4th. The seeds of Millefoil, Yarrow, *Achillea millefolium;*
———— Field mint, *Mentha arvensis;*
———— Scottish parsley, *Ligusticum Scotticum;*
———— Fool's parsley, *Aethusa cynapium;*
and, in general, those of every astringent and aromatic plant that can conveniently be procured, including cresses, thyme, &c.

"A small mixture of such seeds as these may without much difficulty or expense be obtained, and must be of use to the sheep, when sprinkled, as convenience admits, in their pasture fields.

"5th. A number of valuable plants are found to rise spontaneously in our soundest sheep walks; yet most of them, if desirable, may also be propagated by seed. The plants of Millefoil, above mentioned, are often very abundant naturally; and also those of Broom, *Spar-*

tium scoparium, Whins, or Gorse, *Ulex Europæus*; Sheep sorrel, *Rumex acetosella*; and Junipers. On a farm liable to the rot, a park of old grass, intermixed with these and other astringent or aromatic plants, acceptable to sheep, might prove a valuable acquisition to the farmer, by furnishing a proper receptacle for a few sheep under suspicion of this distemper.

"Let it be observed, among the last hints suggested for the purpose of curing or preventing the rot, that barks are considered exceedingly good, for counteracting this disease, chiefly those of the oak, elm, and sallow. But it cannot be recommended to admit sheep into plantations of young trees. A safer and readier method may be, to cut off some branches of oak, elm, sallow, pines, and other trees, and to throw them immediately into the sheep's inclosure, where diseased animals have been confined. They will readily fall to work and brouze on some of them, directed by nature, if they be of service to them: for sheep frequently do eat the barks and branches of these and other trees, when they have liberty to resort to them, while young, and within reach."

Shelter in winter is almost as necessary as food; and the want of it is often productive of bad consequences, by impairing the strength and vigour of the sheep. Stone rounds, or small inclosures capable of holding ten or fifteen score of sheep, and about six feet high, seem best for them in the season of storm and distress. Walls also built in the form of an H or X, or of a semicircle, are remarkably useful for preserving them from the violence of boisterous rainy weather, or the chillness of dry cold winds; and upon extensive farms, small plantations upon different corners of them might prove highly beneficial. In placing the means of shelter and retreat in bad weather, care should be taken to have them upon suitable parts of a farm, where they may be at moderate distance, easy and convenient for the different hirsels, each of which should have its own round, as near its pasture as possible. They should always be built in low situations, protected from the wind, and, if possible, where two waters or rivulets meet. Without such protection, the sheep must stand exposed all the time, or be driven a mile or two, by the violence of the storm. The uniform soundness of pet sheep is undoubtedly owing as much to their protection in winter as to the food which they eat.

On all soft grounds stocks should be kept young, for by eating great bellyfulls of soft grass sheep break down in their bodies, and fail much sooner than when fed upon hard sound land. When their constitution begins to fail, even their accustomed food will not support them; and besides, their teeth get so wide, that they cannot eat fine grass, and are obliged to take to the tath, which subjects them to rot.

It is scarcely necessary to observe, that every thing which tends to debilitate sheep, or hurt their constitution, should be carefully guarded against. They should be dealt with as gently as possible, and never severely dogged. The lambs should be weaned as early as possible, and the ewes never milked on any account. Gimmers, if too long suckled, are sure to rot, and go wrong the following spring, when they are finishing their third year.

In short, as Mr. Bryden justly observes, the best means of preventing rot, is to keep sheep at all times at a regular maintenance, and neither give occasion nor opportunity for a sudden decay.

Cure.—As soon as there is any appearance of the rot, such food as they delight in should be offered to them, and their appetite excited by a little gentle exercise. As long as their bellies are light, a bite of broom, heather, or sea-marsh twice a day, will in general recruit them. Salt is a known antidote in this disease. Sheep are also naturally fond of salt, when they have free access to it. They have been known to run to salt in wooden buckets, and to lick the salt bags hung up in their folds; to eat salted hay, and to drink out of cisterns having salt in solution among the water. On a small scale, it may even be given in water by the hand, and poured down their throats. Of all medicines, it is the safest and most effectual against this distemper.

With respect to the cure of it by medicines, little can be said with certainty. The leaves of elecampane, coltsfoot, honey, plantain, foxglove, &c. have all been recommended, but undeservedly, except the foxglove, which seemed to Mr. Stevenson to arrest materially the progress of the disease in those cases in which it was tried. A handful of the leaves was boiled in a Scotch pint of water until it was reduced to three mutchkins, and of this decoction two tea spoonfuls were given three times a day, with a little molasses and water.

The following receipt has been recommended as very efficacious. Steep four pounds of antimony in two gallons of ale, for a week, and give the sheep a cupful of it night and morning.

On Marl, Chalk, and Clay.

By the Rev. JAMES WILLIS, *of Sopley, Ringwood, Hants.*

(Concluded from Page 319.)

THE failure of the before-mentioned crop he attributes solely to the neglect of giving the land a winter's fallow, whereby the opportunity was lost of getting the field sufficiently light and clean, so as to do credit to the system of marling. The farmer was rather aware of the consequences; but it arose, partly for want of time to fallow the ground, and partly with a view of satisfying himself and others, as to the absolute necessity of perfectly fitting your soil for the reception of marl. These experiments, although expensive to the individual, have their use; the inferiority of a crop for one year, on ten acres, will not sink very deep in the pocket of a wealthy farmer; and the failure in the process will convince the most positive, that the best and safest way is attentively to pursue that form or mode of cultivation, which profit and practice have fully proved to be the most efficient to the cultivator, and consequently no less to the nation at large.

On Chalk.

As I before observed, Mr. Whicher has not only marled once, but chalked twice, some parts of his farm, which time and experience alone convinced him was proper to be done. In the year 1804 he took a small estate into his hands, sadly neglected, and overrun with charlock and corn marygold, in a degree not easily described: the land naturally good, a sandy loam, one foot deep to a gravelly bottom. As the staple was promising, it deserved his earnest attention; and as he had tried the chalk system of improvement with success on his large farm, he despaired not of renovating this exhausted farm in a few years to the extent of his wishes, by adopting the same method of improvement. The first step taken was to plough up a field of sixteen acres from a grass lay, the first week in October 1804; fifteen cart-loads of manure from the stable-yard were put on each acre, the usual dressings, preparatory to a wheat crop, which was the 30th of October sown. The first frost after Christmas he carried on the young wheat, chalk, in quantity four waggon loads *per* acre. To prevent the wheat receiving an injury from the pressure of a full waggon load, the chalk was put in a light cart, and spread with a shovel, so as to cover the crop as even as possible. When the frost has separated it completely, the first dry day in March, to harrow it into the growing crop, is indispensably necessary, and the following rains wash it into the soil most cordially. Nothing but rolling and weeding were done after. At harvest, the return of wheat seven sacks *per* acre, and the land at the Michaelmas preceding, considering the state it was in, may be thought to be worth 5*s.* *per* acre; but the field, if we judge from the produce, in twelve months was worth 30*s.* *per* acre. A wonderful effect certainly took place in the nature of this field by chalking. Charlock, and particularly the corn marygold, disappeared, which eat up the substance of the land entirely, so that previous to this operation the field would not return the seed sown.

I must observe that wheat as well as barley, after chalking, yields a grain perfectly bright and clean, and of a greater weight; and they command the best prices at the market, for the special purposes of seed corn. This field, after the wheat was fallowed for the winter, was ploughed twice in the spring, in April sown to barley. The crop was remarkably stout, and produced five quarters *per* acre. Rye grass and broad clover, as is customary in this vale, was harrowed into the land with the barley, which also has returned a most abundant crop.

If we calculate the value of the three years produce from this field, the wheat at 20*l.* a load, the barley at 30*s.* *per* quarter, and the rye grass a ton *per* acre, 4*l.* *per* load, the amount will be little short of the fee simple of the field, taken at thirty years purchase. This land previous to chalking could not more than liquidate the rent and taxes, as indeed was the case, for the farmer that occupied it before Mr. Whicher absolutely starved himself, and the estate into the bargain.

We have two chalk pits, each fifteen miles distant from this farm, the one hard and dry, the other unctuous and fat. The soapy chalk works freeer and much quicker in the soil than the former, and stands longest in the ground. Mr. Whicher had the curiosity to spread this field over with the two sorts; the half that received the soapy quality proved certainly the best by a bushel *per* acre, and this circumstance is attributable to the quicker dissolution of one before the other. This difference is found only in the first year's crop; if the effect was durable, there would exist a sound reason to prefer one to the other.

Every vacant day in the summer months is employed in bringing either chalk or marl; the farmer keeps a magazine of chalk in his yard, which he repairs to in the spring, whenever he carries it on his young wheat. If the farmer was reduced to the necessity of hiring, every waggon load would cost 30s. This is the current price paid to this day for a waggon load at either pit, besides 2s. *per* load is paid to the proprietor. As little or no difference is visible, as before observed, but in the first year, some farmers set the durable quality of the one against this advantage of the other; and if there is a preference it is given to the former.

Pease, vetches, and barley, in this loamy soil, are more productive with either sort of chalk than with marl; and experience has convinced us, that wheat, oats, and beans, in the heavier lands, do much better with marl; the changes have been tried every way with the different seeds, varying the culture on the different soils; and the result of the experiments have finally settled the system of applying chalk and marl as manures, the most beneficially. The method as described by me, is therefore the one that universally prevails in this part of the world. It will be observed, that our method is the reverse of the practice adopted in many parts of the kingdom. Marl consolidates the texture, and sweetens the soil of sandy loams; chalk separates and divides clays, and renders it light for culture. I can only say, that the forty years' experience of this judicious cultivator, as well as of many others, who have invariably pursued his plan, indisputably confirms the fact, that either of these manures may be used with the greatest advantage on any quality of land whatsoever. Mr. Whicher has carried four loads of chalk on clover and rye grass, *per* acre, as well as on a lay; he found it sweeten the old pasturage, and thicken the sward of the new. This was done in October 1804; the hay from new land, sixteen acres produced twenty tons, and the feed of pasturage was increased in the same proportion.

Mr. Whicher never attempted chalking grass until this year. Having more than he wanted for his wheat crop, he was induced to employ the overplus in this manner, which, from the immediate alteration it made in the nature of the ground, has and will pay him for his labour most amply. The frost and the rains of the whole winter, as it happened, washed in the particles of the chalk most completely, as the crops of both fields, by its extraordinary growth, fully convinced him. Chalk appears to be a better dressing for hay-grass than marl. Mr. Whicher has tried this also on four acres; four loads on one, and the same on the other; the two manured with chalk had the advantage very considerably over the two acres dressed with marl, and has produced since 1804, when the experiment was begun, at least a third more food for sheep, horses, and cows.

On Clay.

Mr. Whicher never employed clay as a manure but once; then it was merely accidental. He removed an old mud or clay wall, on a seven acre field, rye grass, and bread clover, in October 1801; he had a quantity sufficient to cover two acres out of the seven acres, at the rate of ten cart loads *per* acre. Great pains were taken to pulverize the same, that the winter's rain might wash it the more effectually into the land. In the spring months, the two acres had the superiority over the five acres, which were manured with turf ashes, in the same month, at the rate of ten cart loads *per* acre. However, in the course of the summer their difference disappeared, and at the hay harvest the ashes beat the clay at the ratio of six to four! Perhaps the clay was not incorporated with the soil so intimately as the ashes in the first year, or probably it might have lost its nutritive qualities, if ever it possessed any, as it had been in the shape of a wall for not less than a century, so that its operation on these two acres may not be considered a fair trial of merit in the quality of the two manures. Had the clay been immediately taken from the pit, or mellowed by being exposed to the atmosphere for a twelve month, and then turned once or twice purposely for dressings, the effect might have been in favour of the clay. The experiment, accidental as it was, is certainly inconclusive; clays are of such different sorts and qualities, that to distinguish properly their powers on vegetation, each sort should be specifically used, in order to ascertain its value.

I have an opportunity of reporting to the Board the only experiment I know of relating to clay. Mr. Wimpey, whose works are well known in the Agricultural world, was impressed with a notion, that clays were as good manures as marl or chalk; and while his neighbours were applying these to their lands, the expense he considered as thrown away, while clay was contiguous to their farms, and to be laid on their fields at one-tenth of the expense and labour: to convince his neighbours of his wisdom, and their folly, he carried different kinds of clay on a ten-acre field, ten loads *per acre*, treated in all respects on the land, as I have spoke of marl, some part of them arable, some pasture. It was applied as a top dressing for the pasture, and ploughed in on the other; two acres sown with wheat, two acres with beans, two acres with oats, two acres with barley, the rest of field, two acres, remained rye-grass; the

soil,

soil, a black sandy loam on gravel. The drill husbandry was used, for which he was a great advocate, to give not only the crops but the clay, as he conceived, every possible advantage. His neighbours of course waited with some anxiety till the harvest, to see in these crops the wonderful effect of clay, compared with theirs, under the old system of marl and chalk. I shall only say, that the whole of his crops were miserable indeed, while his neighbours were as usual; and by woeful experience he found, in his too sanguine recommendation and use of clay, instead of the other two, he became the unfortunate dupe of extraordinary expense and labour, instead of his friends; and the injury, rather than benefit, the land experienced from the use of clay, fully convinced him of his mistake so much, that he abandoned it for ever as an application for manure. Perhaps we may observe, in vindication of the total failure of this experiment, that Mr. Wimpey's clays were of the worst sorts he could possibly have discovered.

But many eminent writers have amply described the operative qualities of marl, chalk, and clay, and their great effects in the aid of agriculture all over the kingdom; and the husbandman that reasons on their quality, and applies them accordingly, must ultimately reap, as to himself, uncommon advantages, and the nation to which such a cultivator belongs, more grain and more cattle for its consumption.

I have only presumed to report to the Honourable Board such local information, under my inspection, respecting the nature, application, and effects of marl, chalk, and clay: if the result of any of the experiments should be in any degree satisfactory, I shall consider myself as amply repaid for my communications.

Account of a new Method of rearing Poultry to advantage. By Mrs. HANNAH D'OYLEY, *of Sion Hill, near North-allerton, Yorkshire.*

With Engravings.

From the TRANSACTIONS of the SOCIETY for the Encouragement of ARTS, MANUFACTURES, and COMMERCE.

The Silver Medal of the Society was voted to Mrs. D'OYLEY *for this Communication.*

I BEG leave to communicate a most desirable method of rearing poultry, which I have proved by experience; the economy and facility with which it may be performed would, if generally adopted, lower the price of butchers' meat, and thereby be of essential benefit to the community at large. I keep a large stock of poultry, which are regularly fed in a morning upon steamed potatoes chopped small, and at noon they have barley; they are in high condition, tractable, and lay a very great quantity of eggs. In the poultry-yard is a small building, similar to a pigeon cote, for the hens to lay in, with frames covered with net to slide before each nest; the house is dry, light, and well ventilated; kept free from dirt by having the nests and walls white-washed two or three times a year, and the floor covered once a week with fresh ashes: when I wish to procure chickens, I take the opportunity of setting many hens together, confining each to her respective nest; a boy attends morning and evening to let any off that appear restless, and to see that they return to their proper places: when they hatch the chickens are taken away, and a second lot of eggs allowed them to set again, by which means they produce as numerous a brood as before: I put the chickens into long wicker cages, placed against a hot wall at the back of the kitchen fire, and within them have artificial mothers for the chickens to run under; they are made similar to those described by Monsieur Reaumur, in his "*Art de faire eclore et d' elevêr en toutes Saisons des Oiseaux domestiques de toutes especes,*" &c. in two volumes, printed at Paris, 1751: they are made of boards about ten inches broad, and fifteen inches long, supported by two feet in the front, four inches in height, and by a board at the back two inches in height. The roof and back are lined with lamb's skins dressed with the wool upon them. The roof is thickly perforated with holes for the heated air to escape; they are formed without bottoms, and have a flannel curtain in front and at the ends for the chickens to run under, which they do apparently by instinct. The cages are kept perfectly dry and clean with sand or moss. The above is a proper size for fifty or sixty new-hatched chickens, but as they increase in size they of course require a larger mother. When they are a week old, and the weather fine, the boy carries them and their artificial mother to the grass-plot, nourishes and keeps them warm, by placing a long narrow tin vessel, filled with hot water, at the back of the mother, which will retain its heat for three hours, and is then renewed fresh from the streamer. In the evening they are driven into their cages, and resume their station at the hot wall, till they are nearly three weeks old, and able to go into a small room, appropriated to that purpose. The room is furnished with frames similar to the artificial mothers, placed round the floor, and with perches conveniently arranged for them to roost upon.

When I first attempted to bring up poultry in the above way, I lost immense numbers by too great heat and suffocation, owing to the roofs of the mothers not being sufficiently ventilated; and when that evil was remedied, I had another serious one to encounter. I found chickens brought up in this way did not thrive upon the food I gave them, and many of them died, till I thought of getting coarse barley-meal, and steaming it till quite soft: the boy feeds them with this and minced potatoes alternately; he is also employed rolling up pellets of dough, made of coarse wheat flour, which he throws to the chickens to excite them to eat, thereby causing them to grow surprisingly.

I was making the above experiments in the summer for about two months, and during that time my hens produced me upwards of five hundred chickens, four hundred of which I reared fit for the table or market. I used a great many made into pies for the family, and found them cheaper than butchers' meat. Were I situated in the neighbourhood of London, or any very populous place, I am confident I could make an immense profit, by rearing different kinds of poultry in the above method for the markets, and selling them on an average at the price of butchers' meat.

A young person of twelve or fourteen years of age might bring up in a season some thousands, and by adopting a fence similar to the improved sheep-fold, almost any number might be cheaply reared, and with little trouble. Hens kept as mine are, and having the same conveniences, will readily set four times in a season, and by setting twice each time, they would produce at the lowest calculation eighty chickens each, which would soon make them very plentiful.

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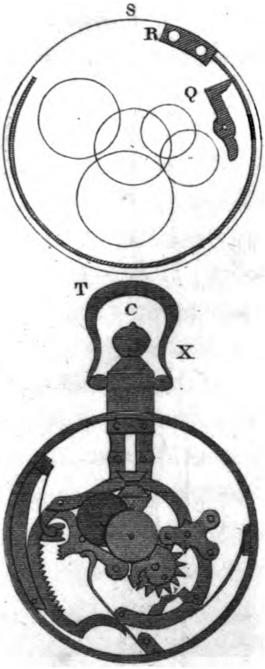
The most convenient size for an artificial mother for forty or fifty young chickens, is about fifteen inches long, ten deep, four high in front, and two at the back; it is placed in a long wicker cage against a warm wall, the heat at about eighty degrees of Fahrenheit's thermometer, till the chickens are a few days old, and used to the comfort of it, after which time they run under when they want rest, and acquire warmth by crowding together. I find it advisable to have two or three chickens among them of about a week old to teach them to peck and eat. The meat and water is given them in small troughs fixed to the outside of the cage, and a little is strewed along from the artificial mother, as a train to the main deposit.

After a certain age, they are allowed their liberty, living chiefly on steamed potatoes, and being situated tolerably secure from the depredations of men and foxes, are permitted to roost in trees near the house.

I herewith send a rough sketch of the apparatus I use, which probably will convey an idea of the business, and not to be too complicated for persons employed in poultry yards, fully to understand; but to prevent trouble and prejudice in the first outset, I think it necessary to remark, that if the chickens do not readily run under the artificial mother for want of some educated ones to teach them, it will be proper to have the curtain in front made of rabbit or hare skin, with the fur side outwards, for the warmth and comfort to attract them, afterwards they run under the flannel ones, similar to the one I sent, which are preferable for common use, on account of cleanliness, and not being liable to get into the mouths of the chickens.

I have had great amusement in rearing poultry in the above

No. 1.



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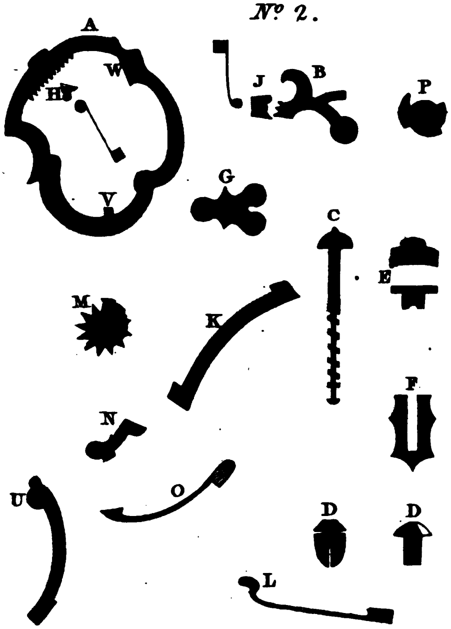

Fig. 5.

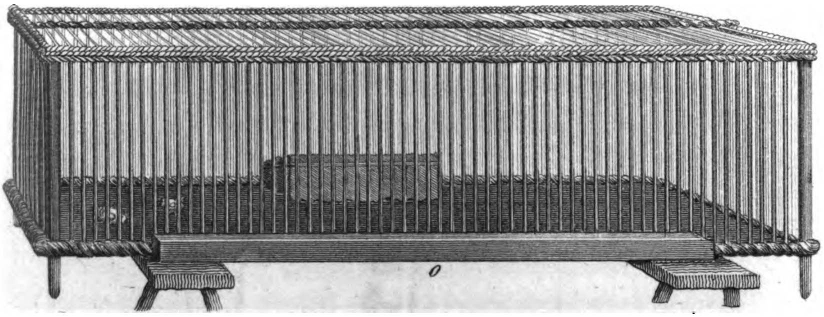

Fig. 3.

Fig. 4.

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above way, and if my time was not occupied with my children and other family concerns, I should most assuredly farm very largely in poultry.

REFERENCE TO THE ENGRAVINGS.

Fig. 3, (Plate XV.) the apparatus called the Artificial Mother, with a curtain of green baize in front and ends, and holes through the top to allow the circulation of air.

Fig. 4, another view of the Artificial Mother, but without the curtain, in order to show its sloping direction, and interior lining of woolly sheep-skin.

Fig. 5, a wicker basket four feet long, two feet broad, and fourteen inches high, with a lid to open, and a wooden sliding bottom similar to a bird cage; the Artificial Mother is shewn, as placed within it.

O. A trough in front to hold food for the chickens.

Description of a Gauge or Measure for Timber.

By Mr. JAMES BROAD, *of Downing-Street.*

With an Engraving.

The Silver Medal of the Society was presented to Mr. BROAD *for this Communication.*

THE instrument I send herewith, is for finding the girth of standing timber, and will, I flatter myself, be found exceedingly useful to all gentlemen, and others having timber to dispose of, and likewise to such purchasers as wish to pay for the true quantity. At present a gentleman having timber to dispose of, is liable to be imposed on to a very large amount; for though some surveyors may be found whose eye is pretty accurate, yet that is far from being generally the case. When an estate is sold on which the timber is to be valued, I believe, there is no other way in general use of finding the girth of a tree (which being squared and multiplied by its length, gives the contents) than by actually getting up to the middle, where the girth is usually taken, with a ladder or otherwise: a method which is very troublesome and expensive where the quantity is large. The seller has, therefore, no way, but at an enormous expense, of finding the real contents of what he has to offer; and as the buyer, if a dealer, from his knowledge is able to form a more accurate judgment, it often happens that the seller sustains much loss. *I have known it exceed* 50 *per cent.* Having some time ago a large quantity to survey, I thought it possible to invent an instrument which would obviate this inconvenience, and which might be sold at a low price, be correct in its work, quick in execution, and such as any capacity might use. I likewise thought it might be so contrived as to make such an allowance for bark, as should be agreed on. The instrument I send you possesses all these qualifications, and is susceptible of several improvements, of which I was not aware when I made it, which I will point out at the end of my letter.

It is well known that the diameter and circumference of circles, are in a certain proportion to each other, and that double the diameter gives double the circumference. The allowance for bark is usually one inch in thirteen, that is, if the greater circumference of a tree with the bark on is found to be thirteen inches, it is supposed it would be only twelve inches if the bark was taken off.

The instrument is composed of two straight pieces of well-seasoned deal, about thirteen feet long, joined together by a pin going through them, on which they are moveable, but neither the length nor thickness are of any particular consequence, as by following the directions hereafter given, they may be made of any size. A little way from the larger end is a brass limb, I call the index, on which are engraven figures denoting the quarter-girth in feet and inches. To use this instrument, it is only necessary to take hold of the large end, and apply the other to that part of the tree where you wish to know the girth, opening it so wide as just to touch at the same time both sides of it, without straining it, keeping the graduated side of the index uppermost, on which the greater girth will be shewn, after allowing for the bark, by the inner edge of the brass on the right hand leg. An operation so easy and simple, that a person of the meanest capacity might measure a great number of trees in a day.

For taking the height of a tree, I would recommend deal rods of seven feet long, made so as to fit into ferrils at the end of each other, tapering all the way in the same manner as a fishing rod. A set of five of them with feet marked on them, would enable a man quickly to measure a tree of more than forty feet high, as he would be able to reach himself about seven feet.

The improvements it is capable of, are, making a joint in the arch or scale, to enable it to shut up (when the legs are closed) towards the centre, which would make it easier to carry. Secondly, as it sometimes happens that standing timber is sold without any allowance for bark, and at other times with a less allowance than one inch in thirteen, two other scales on the index might be added in such cases, one without any allowance, and the other to allow as might be agreed on. I would have added these, but thought the Society would rather see it in the state in which it has been tried on a large survey, as any artist can with great ease add whatever scale he pleases. The present scale allows one inch in thirteen for bark, and is calculated on the following data. The diameter of a circle whose quarter circumference is 26 inches, is $33\frac{80}{100}$ inches. The diameter of a circle whose quarter girth is $6\frac{1}{2}$ inches, is $8\frac{27}{100}$ inches. To graduate the scale, the instrument is opened so as to take in at the small end between the touching points $8\frac{27}{100}$ inches, and a mark is made on the arch to denote 6 inches quarter girth: it is then opened so as to take in $33\frac{80}{100}$ inches, and another mark is then made on the arch, to denote two feet quarter girth; (these marks are made close to the inner edge of the brass on the right hand limb): the space between them is then divided into eighteen parts, which represent inches, and are again divided into half, for half inches; if any notice is to be taken of quarter inches, the eye will easily make a further decision.

REFERENCE TO THE ENGRAVING.

Fig. 4, (Plate XVI.) *a a a a* two long pieces of well-seasoned wood, joined near the middle by a pin *b* going through them, forming an axis on which they move; *c c*, two pieces of brass screwed near their upper ends, on the sides opposite to each other, and projecting over to form the measuring points. *d*, the index fastened to one of the pieces of wood at *e*, and moving freely under a small bar at *f*; *g g* screws with nuts placed in the middle of the long slits of the two arms, to wedge them

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Fig. 4.

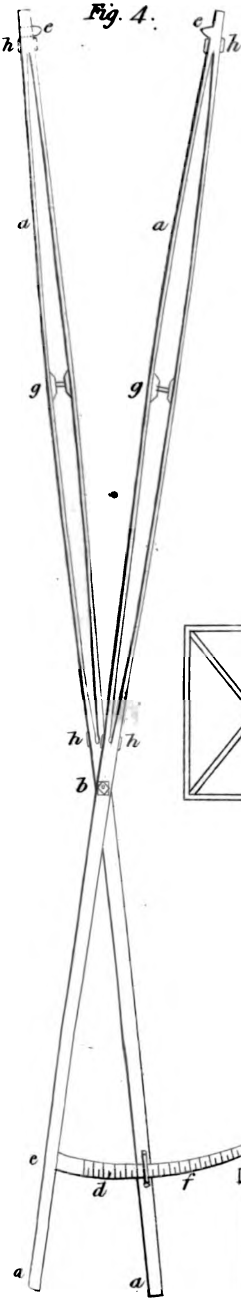


Fig. 1.

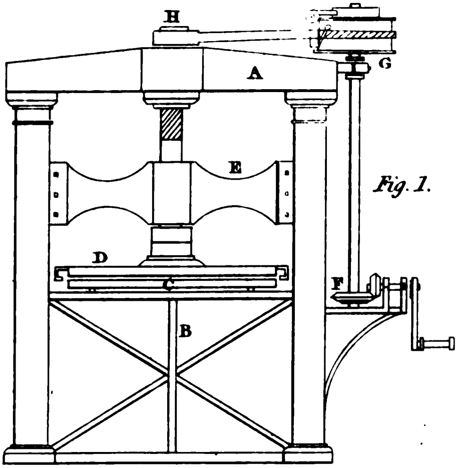


Fig. 3.

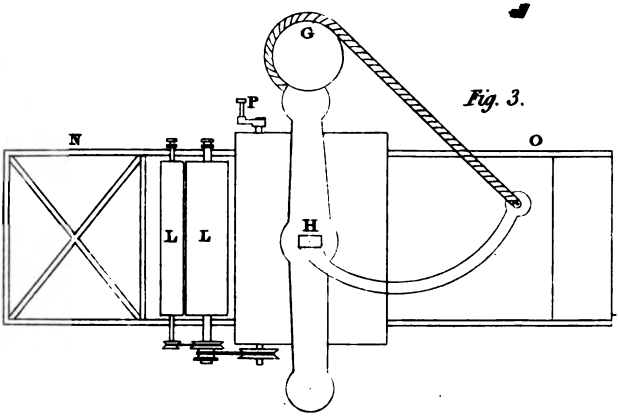
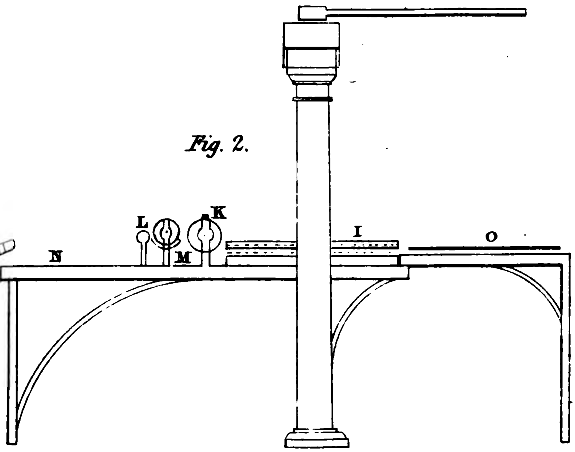


Fig. 2.



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them open, whereby the vibration is destroyed, and the arms, though light, are rendered stiff; *h h h h* screws and nuts to prevent the arms from splitting.

* * *

A Certificate from Mr. J. Wilkins, carpenter, of Sandy Lane, dated May 4, 1805, stated, that he had used the instrument invented by Mr. J. Broad, for measuring timber standing, and that he believes it to be a correct and valuable one.

An Account of the Progress and present State of the Works undertaken with a view of forming a Tunnel under the Thames. Communicated in a Letter to the Editors.

With a Plate.

GENTLEMEN,

THE Directors of the Thames Archway Company having circulated among the Proprietors a printed account of the state of the works, and advertised handsome premiums for the best plan for completing them, I take the liberty of transmitting to you one of these circulars, presuming that it is not incompatible with the design of a work devoted solely to the advancement of the useful arts to insert it therein, and that many of your readers would be gratified by its appearance. The object of this statement being to procure the best plan for the completion of so useful, so peculiar, and so important an undertaking as the forming a road under a great river, you will be forwarding the views of this Company by inserting a copy of the enclosed, or the substance of it, in the Repertory of Arts, &c and oblige

A CONSTANT READER,
and a Proprietor of Thames Archway Company.

"This Company was established by Act of Parliament for the purpose of forming a tunnel under the river Thames either for foot passengers or carriages, or for both; and by the unanimous opinion of every engineer who had been consulted, it was deemed necessary, as a preparatory step, to make a drift-way to extend as far as the deepest part of the river; and according to the original plan of this undertaking, it was intended then to begin to construct the tunnel, carrying it forward in both directions from the centre to the North and South sides of the river; a shaft was therefore sunk on the South side near the Horseferry, Redriffe, and a drift-way made to the point first proposed. It was however then determined to continue the drift to the opposite shore, in the line and direction of the proposed tunnel, for the sake, amongst other reasons, of exploring the ground through which that part of the tunnel was intended to pass; and thereby enabling the engineer to anticipate and guard against difficulties.

In pursuance of this determination the drift-way was carried on to the extent shewn in the accompanying plan, at A, when the engineer proposed another mode of executing the tunnel, and, in his opinion, much less difficult and less expensive, and for which the further extension of the drift would be useless; the Directors being convinced that there are many methods of accomplishing the object, and that it is their duty to procure the best in their power, thought proper, before this or any plan were adopted, to suspend the works, and to invite ingenious men of every description to a consideration of the best means of completing so useful and so novel an undertaking.

With this view the Directors are induced to offer the following premiums, namely,

Two hundred pounds to the person whose plan shall be adopted and acted upon; and a further sum of *three hundred pounds* if it be executed.

The first premium to be paid within three months after the plan shall have been put in execution. The second premium within three months after the tunnel shall have been opened for passengers.

The plans to be accompanied with full and clear specifications and directions how to carry them into execution, and an estimate of the expense. They must be signed by fictitious names, mottos, or marks, and will be returned if not adopted to any person claiming them under the fictitious name, motto, or mark; the real name to be enclosed in a sealed note, and externally marked with the fictitious name, &c.; which note shall not be opened unless it be that of the person whose plan shall be adjudged entitled to the premium.

All the plans will be submitted to the judgment of eminent and competent persons chosen by the Directors, who shall not be either Proprietors or Competitors; so that every person offering plans may rely upon the fairness and impartiality of the decision.

The plans must be delivered at the office of Mr. Wadeson, in Austin Friars, London, Solicitor to this concern, on or before the first of June next.

To enable engineers and others to form correct opinions on the subject, the Directors have caused the following account of such facts as were noted to have occurred in the progress of the undertaking, to be extracted from the Engineer's journal, which is accompanied by an engraving shewing the plan and section of the works as far as they have proceeded.

Fig. 1 (Pl. XVII.) is the section of the river, shaft, and drift-way, B the shaft on the South shore lined with nine inch brick-work laid in cement impervious to water. The strata through which it passed consisted,

	Ft.	In.	Ft.	In.
1. Brown clay	9	0		
2. Loose gravel with a large quantity of water	26	8		
3. Blue alluvial earth inclining to clay	3	0		
4. Loam	5	1		
5. Blue alluvial earth inclining to clay, mixed with shells	3	9		
6. Calcareous rock in which are imbedded gravel stones, and so hard as to resist the pick axe and to be broken only by wedges	7	6		
7. Light coloured muddy shale, in which were imbedded pyrites and calcareous stones	4	6		
8. Green sand with gravel and a little water	0	6		
9. Green sand	8	4		
			68	4
From the surface of the ground to high water-mark			8	0
Depth of the shaft from high water mark			76	4

The gravelly stratum No. 2. in the shaft extends about 400 feet into the river from high water mark at T to V; at this latter place it is about two feet thick, and underneath is alluvial earth approaching the nature of clay.

The framing of the drift consists of three inch plank, five feet high, three feet wide at bottom, and two feet six inches at the top inside.

Fig.

Pl. XVII. Vol. XIV. Second Seri

Tunnel under the Thames.

Fig. 1.

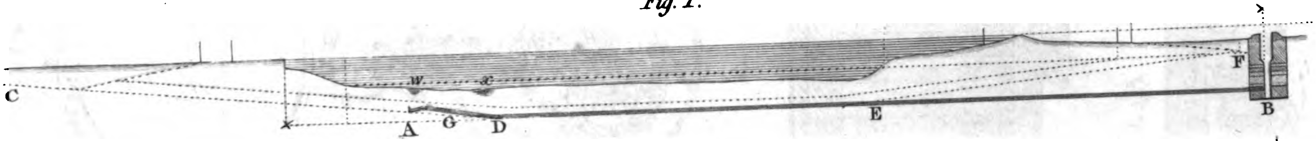

Fig. 2.

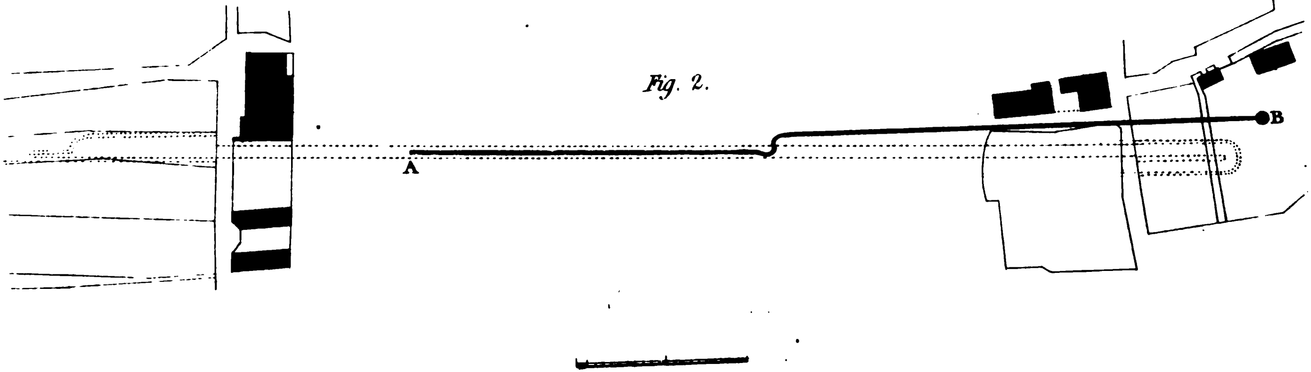

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Fig. 2 is a plan of the drift-way and shaft.

In proceeding with the drift-way from the South to the North shore, the strata were constantly varying at the face of the drift as noted at the following places specified. The variations in the intermediate spaces were not noted.

Face of the drift at the entrance from the shaft, measuring from the bottom upwards,		Ft.	In.	Ft.	In.
Green sand		4	6		
Gravel		0	6		
				5	0
At 177 feet from the shaft,					
	Green sand	4	0		
	Gravel	0	6		
	Blue muddy shale	0	6		
				5	0
At 234 feet,	Green sand	3	9		
	Gravel	0	3		
	Blue muddy shale	1	0		
				5	0
At 295 feet,	Green sand	3	7		
	Gravel	0	3		
	Blue muddy shale	1	2		
				5	0
At 317 feet,	Green sand	3	5		
	Gravel	0	4		
	Blue muddy shale	1	3		
				5	0
At 321 feet,	Green sand	3	3		
	Gravel	0	4		
	Blue muddy shale	1	5		
				5	0
At 333 feet,	Green sand	3	3		
	Gravel	0	4		
	Blue muddy shale	1	5		
				5	0

At 350 feet,	Green sand	2	8		
	Gravel	0	4		
	Blue muddy shale	2	0		
		——		5	0
At 493 feet,	the green sand ends.				
At 730 feet,	Hard calcareous rock, mixed with loamy land	——		5	0
At 799 feet,	Hard rock	——		5	0
At 858 feet,	Ditto	——		5	0
At 901 feet,	Ditto	——		5	0
At 931 feet,	Rock, with a little sand and shells, and water in the roof	——		5	0
At 945 feet,	Hard rock	2	6		
	Clay and shells	2	6		
		——		5	0
At 966 feet,	Rock	0	3		
	Clay	0	4		
	Shells	2	0		
	Clay	1	0		
	Cockle shells	0	4		
	Clays and shells	1	0		
	Sand	0	2		
	Clay	0	6		
	Sand	0	5		
		——		6	0
At 972 feet,	Clay and shells	4	0		
	Sand	1	0		
		——		5	0
At 992 feet,	Clay and shells	0	8		
	Sand	4	4		
		——		5	0
At 1011 feet,	Sand	3	6		
	Clay	1	6		
		——		5	0

The quantity of water in the gravelly stratum No. 2 of the shaft, was so considerable, that a fourteen-horse engine could only keep the water a few feet below its natural level, and the shaft was sunk through, by far the greatest part of this stratum, into the blue stratum No. 3, with the water standing in it to the depth of several feet. It is well ascertained that this stratum of gravel extends through a considerable part of the adjoining country; but borings being made in the shaft from the bottom of this stratum, no water was met with in the sub strata to the depth of eighty-six feet from high water, where a spring was discovered, which rose in a few hours, through pipes inserted for that purpose, to a higher level than that in the gravelly stratum No. 2. The shaft was therefore sunk only to the depth of seventy-six feet four inches.

The drift was then carried forward in a horizontal direction to the North, five hundred and fifty-nine feet. And, in order to explore the ground in the Northern part of the line of the then proposed tunnel, the drift was turned to the West twenty-three feet six inches from the centre of the former line to the centre of the new direction, and then to the North, as shewn in Fig. 3, (intended to be enlarged afterwards to the size of the tunnel) and carried forward three hundred and forty-one feet, making the distance from the shaft to the beginning of the rise at D nine hundred and twenty-two feet. Through the whole of this line no material interruption occurred; the strata, as shewn above, consisted of firm sand, calcareous rock, and concreted gravel, with no more water than was easily kept under by a fourteen-horse engine.

At the point D the drift was made to incline upwards at the rate of one foot in nine. In prosecuting this part of the drift, at the distance of twenty-three feet from the beginning of the incline, the earth in the roof broke down, and discharged a great quantity of sand and water into the drift. At the time this circumstance happened, a space of only six inches by thirty of earth in the roof and none in the face was left untimbered; and through this space the earth kept falling by degrees, until a hole was formed capable of letting a man stand up in it; who observed a quicksand, about three feet thick, and about four or five feet above the roof of the drift. The stratum between the drift and sand was clay; water flowed from the sand. The hole was after some difficulties filled up, and the works proceeded.

From the observations which had been made in the progress of the drift, the engineer found that the strata dipped slightly from the South to the North, and concluded that the gravelly stratum No. 2 in the shaft would end in quicksand. This inference was confirmed by borings in the North shore at E, and by the fact that the wells there are much deeper than on the South. In expectation therefore of drawing off the water from the face of the work, borings were made at D, through the roof of the drift, and pipes forced up to the top of the quick-sand, which had the desired effect. The water came free from sand for a considerable time; but when the sand began to come through any of the pipes they were plugged up, and others occasionally inserted in different places to the South of these, with the same object in view; and which kept the face of the work dry. By this means, and by using the utmost precaution in all other respects, the drift was afterwards extended seventy feet beyond this fracture; where the roof broke down a second time, and sand and water entered the drift-way with great violence, and to an alarming degree; so that in about a quarter of an hour the water rose in the shaft nearly to the top of it. On examining the river an opening or hole at *w* was discovered in the bed, of about four feet diameter and nine feet deep, and its sides nearly perpendicular. Into this hole, clay partly in bags, and other materials, were thrown, sufficient to fill it up; and which succeeded in stopping the communication between the river and the drift. The face of the drift was again opened, but the men could make but little progress, as the water and sand frequently burst in upon them, and drove them away. Pipes were again put up at G, and the drift was extended twenty feet six inches further, in nearly a horizontal direction, through the quicksand. The face was then timbered up, to prevent any further fall of earth or sand; and a pipe nine feet long forced upwards diagonally at the face of the drift. The first eight feet through which this pipe passed was blue clay, and the last foot quicksand, of which a considerable quantity immediately flowed into the drift. This pipe soon became clogged up, it is presumed with clay, as some lumps came through nearly as large as the diameter of the pipe. Another pipe, eight feet six inches long, was inserted horizontally in the face, and discovered nothing but blue clay: no sand nor water came through it.

At this period the Engineer reported, that he had examined the bed of the river, and found the hole at *w* considerably increased both in width and depth, and the earth at *x* very much sunk; and that he had no doubt these two fractures communicated underneath.

He then gave it as *his opinion* that an *underground* tunnel could not be made in that line, unless the fractures were covered by caissons, without which the further progress of the drift would be useless; but that he had no doubt of being able to make a tunnel over the *same* line through the river, sufficiently deep into its bed, by means of moveable caissons, or coffer-dams, and at a less expense considerably than the original estimate for the underground plan; and *without any impediment to the navigation of the river.* Under these circumstances the further progress of the works was suspended. But the Directors think it necessary to state, that although the Engineer then in the Company's service was of opinion that an underground plan could not be executed in or very near the proposed line, yet there are others of a contrary sentiment; and notwithstanding the Directors are in possession of designs or plans (which may be inspected on application at the Clerk's office in Austin Friars) for completing the undertaking, yet wishing to avail themselves of all the ability of their Country, in an undertaking of such novelty and importance, it becomes their duty to await the event of this address to the public, before any plan be adopted, however considerable its merits, or however eminent its authors.

In the design of any plan for this concern, Engineers will doubtless pay particular attention to the difficulties which are likely to occur, from the situation of the quicksands, the communication with them and the river, and the falls in the bed of the river. And that they will not consider themselves as prevented from offering plans for executing the tunnel through the river itself, by means of caissons, coffer-dams, or any other method (if such method appear to them preferable to the underground mode), provided in the execution of such plans *no impediment be occasioned to the navigation of the river.*

It is necessary to state that any alteration in the line of the tunnel can be but inconsiderable, as it must be confined within the limits of the ground laid down in the accompanying plan.

It is an important consideration with the Company, that the size of the tunnel be large enough to admit two carriages to pass each other; or two of smaller dimensions, each to admit a carriage.

The Company contemplate a foot tunnel, only in the event that a larger one should appear to be impracticable.

The plans must be formed with regard to the tunnel being lighted.

N. B. That plan whose line is the shortest, and ascent the easiest, will have great claims to preference, if equal in merit in other respects."

REFERENCE TO THE PLATE.

Fig. 1 (Plate XVII.) section of the river and works. Fig. 2 plan of the same.

B the shaft. A B the drift-way, as far as it has been executed. The dotted lines D *e* and E F, Fig. 1, shew the proposed ascent and opening of the tunnel. The dotted lines in the plan, Fig. 2, shew the proposed direction of the tunnel. The width of the river at low water is 649 feet, at high water 850 feet. The distance between the drift-way and the bottom of the river between D and E is no where less than 28 feet, and from D to A no where less than 25 feet.

The parts shaded in plan Fig. 2 are buildings.

On

On the Decomposition and Recomposition of the Boracic Acid.

By Messrs. GAY-LUSSAC and THENARD.

From the JOURNAL DE PHYSIQUE, November 1808.

IT was announced, in a note read the 21st of last June, at the Institute, and printed in the Bulletin of the Philomathic Society for July, that by treating fluoric and boracic acid with the metal of potash, results were obtained that could not be explained, but by supposing these acids to be compounds of a combustible base and oxygen. Nevertheless, as these acids had not been recompounded, this analysis was not given as being perfectly demonstrated. Since that time the researches have been continued and varied; and it is now certain that the composition of the boracic acid is no longer problematical. In reality, this acid may be decomposed and recomposed again at pleasure.

To decompose it, equal parts of metal of potash and of very pure vitreous boracic acid were put into a copper tube, to which a bent glass tube was fitted. The copper tube was placed in a small furnace, and the extremity of the glass tube plunged in a basin of quicksilver. The apparatus being thus prepared, the copper tube was heated by degrees until it became slightly red, and it was kept in that state for a few minutes; when the operation being stopped, the apparatus was cooled and the matter taken out. The following were the results of this experiment.

As soon as the temperature was raised to about 150, the mixture became suddenly red, a circumstance that was more strikingly seen when a glass tube was used. Much heat was produced, so that the glass tube was partly melted, and sometimes broken, and almost the whole of the air in the apparatus was driven out with great force. From the beginning to the end of the experiment, only atmospheric air was disengaged, and some bubbles of hydrogen; which latter were not the fiftieth part of what the metal of potash that was employed would have disengaged from water. All the metal disappeared, although it decomposed; only part of the acid was decomposed; and these substances were changed by their reciprocal action into an olive grey substance, which is a compound of potash, and of the basis of boracic acid. This mixture was taken out of the tube by pouring water into the tube and heating it gently; and the boracic radical was separated from it by washing it with hot or cold water. It is, however, best to saturate the alkali contained in the residual mixture with muriatic acid, before the washing is performed; for it appears that the boracic radical is capable of being oxydized, and even dissolved by the alkali, to which it communicates a very dark colour. That which does not dissolve is the radical itself; which possesses the following properties.

This radical is greenish brown; fixed, and insoluble in water. It has no taste, nor any action on tincture of litmus, or on syrup of violets. Being mixed with oxymuriate of potash, or nitrate of potash, and projected into a red hot crucible, it entered into a vivid combustion, of which the boracic acid was one of the products. When treated with nitric acid, it made a great effervescence even in the cold; and when the liquor was evaporated, much boracic acid was obtained. But the most curious and most important of all the phenomena produced by the boracic radical when placed in contact with other bodies, are those that it presents with oxygen.

When three decigrammes (four and a half grains) of boracic radical were projected into a silver crucible, ignited to a dark red, and the crucible covered with a jar, containing about a litre (two pints and one eighth) of oxygen, and the whole placed over quicksilver, a most rapid combustion took place, and the quicksilver rose to about the middle of the jar. Nevertheless the combustion of the boracic acid was far from being complete in this experiment. The cause of this hindrance is, that the radical is converted at first into a black oxyd, as is now first discovered, and the external parts of this oxyd changing afterwards into boracic acid, it melts and hinders the oxygen from acting upon the internal parts. Therefore if a complete combustion is desired, it is necessary to dissolve away this acid, and treat the remainder with oxygen, at a cherry red heat. It then burns with less violence, and absorbs less oxygen than before, because it is already combined in some measure with oxygen, and the external parts changing as before into boracic acid are melted, and again hinder the combustion of the external parts. So that to convert the whole into boracic acid, it must be subjected to a great number of successive combustions, and as many washings.

In these combustions, oxygen is always absorbed, without the disengagement of any gas, and they all produce a sufficient quantity of acid to yield crystallized boracic acid by treating the products with boiling water, aided by a proper evaporation and cooling. Of this acid, a specimen is presented to the Institute.

The boracic acid also exhibits the same phenomena with air as with oxygen; the only difference is, that the combustion is less rapid.

It follows from these experiments, that the boracic acid is composed of oxygen and a combustible body. Every thing shews that this substance, which it is proposed to call borium *(bore)* is of a peculiar nature, and ought to be classed with phosphorus, carbon, and sulphur. It appears that it requires a great quantity of oxygen to change it into boracic acid, and that it previously passes into the state of a black oxyd.

Notes.

Many chemists have made experiments on the decomposition of the boracic acid, from whence they have drawn different consequences.

Fabroni supposed that this acid was a modification of the muriatic acid, see Fourc. Sys. Conn. Chim. art. Acide boracique.

A long series of experiments on the phenomena which resulted from treating the boracic acid with oxy-muriatic acid may be found in the 5th vol. of the Annales de Chimie, p. 202. These experiments were made by Crell, who concluded from them, that carbon was one of the elements of this acid.

Lastly, Mr. Davy, whose memoir has been in France upwards of two months, on submitting moistened boracic acid to the action of the Voltaic apparatus, observed traces of a black combustible substance at the negative pole; but he acknowledged, that being busied with experiments on the alkalies, he did not follow up this observation.

So that to the present time the elements of the boracic acid were unknown. We had indeed, as mentioned above, announced (21st June) to the Institute, that this acid contained oxygen, and of course, a combustible body; but as we had not then recomposed it, its nature could not be regarded as determined.

On the Action of the Metal of Potash upon metallic Oxyds and Salts, and upon the earthy and neutral Salts.

By Messrs. Thenard *and* Gay-Lussac.

From the Journal de Physique, January 1809.

Being convinced, from a great number of experiments, that it was not possible to obtain muriatic acid perfectly exempt from the presence of any other body, the direct action of the metal of potash upon the muriates was fixed, in order to discover whether the acid would undergo any alteration by this mode of research.

Muriate of barytes, previously melted by a red heat, was pulverized and introduced into a small glass tube, into which a small globule of the metal had been previously placed, but no action took place, neither without nor with heat. The metal traversed the salt without any perceptible alteration; and on water being added, after the matter was cooled, a rapid inflammation took place. Other alkaline muriates did not give more satisfactory results. The insoluble metallic muriates, such as muriate of silver and calomel, were then tried in the same manner. As soon as the temperature was sufficient to melt the metal, the mixture took fire, and the salts were reduced. In both these experiments the tubes were broke; and in that with the muriate of quicksilver there occurred a slight detonation of the mercurial vapour. In both trials muriate of potash only was produced, and there was no trace of the muriatic acid being decomposed.

As these experiments led to no hopes of decomposing by this means the muriatic acid, the action of the metal of potash upon the other salts, and on the metallic oxyds, was inquired into: the preceding mode of trial being constantly adhered to. In all these experiments the heat applied has always been rather more than was necessary to melt the metal. Sometimes, as in the decomposition of phosphate of lime, sulphate of barytes, oxyd of zinc, &c, it has been nearly 300°, Cels. The tubes were always broken whenever the combustion was very rapid. The following were the results.

Sulphate of barytes. Decomposed without flame, and a sulphuret of barytes was formed.

Sulphite of barytes. Brisk flame, a similar formation of sulphuret of barytes.

It may be concluded from these two experiments, that the oxygen is much less condensed in the sulphite of barytes, than in the sulphate; and it is also very probable that the oxygen is less condensed in the sulphurous acid, than in the sulphuric.

Sulphite of lime. Slight flame, a very yellow sulphuret was produced.

Sulphate of lead. Very brisk flame.

Sulphate of slightly oxydized quicksilver. Flame, as when calomel was employed.

Nitrate of barytes. Very brisk flame, and the matter flung out of the tube.

Nitrate of potash. Metal destroyed without flame, which effect is probably owing to the nitre containing water.

Oxymuriatic salts. Very brisk flame.

Phosphate of lime. Decomposition without any appearance of flame, phosphuret of lime was produced.

Carbonate of lime. Decomposed without flame, and charcoal was produced.

Chromate of lead. A brisk flame.

Chromate of quicksilver. Became slightly red; and the matter changed to a green.

Arseniate of cobalt. A brisk flame.

Yellow and green tungstic acids. A brisk flame.

Red oxyd of quicksilver. Very brisk flame, and a slight detonation of the mercurial vapour.

Oxyd of silver. A very brisk flame.

Brown oxyd of lead. The same.

Red oxyd of lead. A brisk flame.

Yellow oxyd of lead. The same.

Yellow and brown oxyds of copper. The same.

White oxyd of arsenic. Flame.

Black oxyd of cobalt. The same.

Volatile oxyd of antimony. Flame, but not so brisk as with the oxyds of copper.

Oxyd of antimony ad maximum. Very brisk flame.

Oxyd of tin, ad maximum. The same.

Common oxyd of tin. Flame, but less brisk than the former.

Red oxyd of iron. Very slight flame.

Black oxyd of iron. No flame, but the iron was reduced.

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Oxyd of manganese, ad maximum. Very brisk flame.
Oxyd of manganese, ad minimum. No flame.
Yellow oxyd of bismuth. Brisk flame.
White oxyd of zinc. Reduced, without flame.
Grey oxyd of nickel. Flame rather brisk.
Green oxyd of chrome. No flame. A black substance was produced, which on being completely cooled, and afterwards exposed to the air, burst into flames, as if it were a very good pyrophorus, and became yellow. This substance is a combination of potash and oxyd of chrome, which is changed by the air into a chromate of potash.

The action of the metal of potash upon the earths, and particularly upon zircon, silica, ittria, and barytes; and the metal was very evidently altered by all these substances: but as the cause of this alteration is not at present well known, no details are here given on this head. It appears however very probable that the phenomena which take place when the metal of potash is burnt in siliceous fluoric acid gas, are in no respect due to the silica.

But, however that may be, it follows from the preceding experiments, that as far as is at present known, all bodies which contain oxygen are decomposed by the metal of potash, and that heat and light are disengaged in almost all these operations, and the more so, as the oxygen is less condensed, so that these decompositions offer a mode of appreciating the degree of the condensation of oxygen in its several combinations.

These are the experiments which, having taken up much time, have hindered the authors from continuing those they had commenced upon the boracic acid. Nevertheless,

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vertheless, it has been discovered that the boracic acid can be decomposed at a very high temperature by a mixture of charcoal and iron, (or platina), and of thus forming borurets; for Mr. Descotils having exposed similar mixtures to the heat of a forge, obtained metallic buttons, which on being treated with nitro-muriatic acid, yielded very perceptible quantities of boracic acid. So that the buttons were, according to the experiments of the authors on the nature of boracic acid, a combination of borium, with platina or iron.

List of Patents for Inventions, &c.

(Continued from Page 360.)

Leger Didot, of Two Waters, in the county of Hertford, Gentleman; for improvements in the construction of umbrellas and parasols. Dated March 1, 1809. Specification to be enrolled within one month.

Richard Scantlebury, of Redruth, in the county of Cornwall, Brazier; for a machine by which he counterbalances the weight of any volume of water or other fluids, required to be lifted by any steam or water engine, or other machinery, either worked by animals or men, which gains a very considerable power over any machine now in use. Dated March 1, 1809. Specification to be enrolled within one month.

Edward Steers, of the Inner Temple, Esq.; for a method, directed by machinery, of using the screw, by which its mechanical power or its motion is increased. Dated March 1, 1809. Specification to be enrolled within one month.

Abraham

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Abraham Seward, of Lancaster, in the county palatine of Lancaster, Tin Plate-worker; for an improved hook for bearing up the heads of horses in drawing carriages. Dated March 1, 1809. Specification to be enrolled within one month.

Thomas Clatworthy, of Winsford, in the county of Somerset, Sheep-shears-maker, and **John Clatworthy**, of the same place, Sheep-shears-maker, his son; for shears, on an improved construction, for shearing sheep. Dated March 1, 1809. Specification to be enrolled within one month.

William Proctor, of Sheffield, in the county of York, Optician; for improved methods of raising or supplying tubes or lamps with oil, so as to remove away the shade of the vessel containing the oil, and in form and use equal to any mould or wax candle, which he denominates *Proctor's spiral Argand and Candle-lamp*. Dated March 9, 1809. Specification to be enrolled within one month.

Frederick Bartholomew Fölsch, of Oxford-street, in the county of Middlesex, Merchant, and **William Howard**, of Bedford-street, Lockfields, in the county of Surrey, Gentleman; for a certain machine, instrument, or pen, calculated to promote facility in writing; and also a certain black writing-ink or composition, the durability whereof is not to be affected by time or change of climate. Dated March 11, 1809. Specification to be enrolled within one month.

John Heathcoat, of Loughborough, in the county of Leicester, Lace-manufacturer; for a machine for the making and manufacturing of bobbin lace, or lace

nearly

nearly resembling foreign lace. Dated March 20, 1809. Specification to be enrolled within six months.

James Hakewill, of Beaumont-street, in the parish of Saint Mary-le-bone, in the county of Middlesex, Artist; for an improvement in the consruction of tables, chairs, and stools, for domestic, military, and naval service, and in the packing of the same. Dated March 20, 1809. Specification to be enrolled within six months.

Simeon Thompson, of Maddox-street, Hanover-square, in the county of Middlesex, Gentleman; for a machine or machinery for raising, lowering, drawing, driving, forcing, impressing, or moving, bodies, substances, materials, fluids, articles, or commodities. Dated March 20, 1809. Specification to be enrolled within one month.

Charles Valentine, of the parish of Saint James, Clerkenwell, in the county of Middlesex, Japanner; for a new mode of ornamenting and painting all kinds of japanned and varnished wares of metal, wood, paper, or any other composition, and various other articles. Dated March 20, 1809. Specification to be enrolled within one month.

END OF THE FOURTEENTH VOLUME.—SECOND SERIES.

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